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Modeling Banks' Risk Taking Behavior in a Presence of the Long-Tail Risk Guarantor with the Truncated Version of the St. Petersburg Coin Flip Model

Peter Sharp and Anna Vygodina

Abstract

This paper draws on the sequential coin toss gamble, used in the St. Petersburg paradox, to model investments with long-tailed risks— those that result in very rare but huge losses. It applies the model to the depository institutions' assets with long-tail risk, where depositors serve as guarantors of tail risk, and also to other investments with long-tails, such as collateralized debt obligations. The model simulates the financial institutions risk taking behavior, where agents with limited liability are able to shift their tail risk onto external parties who have either imperfect information or act with disaster myopia (i.e. “too big to fail” scenario). A simulation shows that such self-interested agents benefit by increasing leverage and increasing the chance of bankruptcy.

I. Introduction

Self-interested agents may be expected to seek investments with long-tail risk if they are sheltered by limited liability and if the long-tail risk is underpriced, hidden, or ignored by their creditors. The long-tail risk investments are those with outcomes that have extremely low chances of very large losses. Hidden tail risk appears to play a part in recent financial events. Some examples include:

- collapse of the hedge fund Long-Term Capital Management
- implosion of investment banks, Bear Sterns, Lehman Brothers
- failure of many structured finance vehicles
- ruin of AIG in the insurance of credit default swaps
- bankruptcy of Fannie Mae and Freddie Mac
- insolvency of U.S. and European banks
- recent failure of the futures broker dealer, MF Global

Indirect costs of the failure of these financial institutions include the general deterioration of world wide economic activity as subsequent credit squeeze impact many kinds of businesses. The events of the financial crises of 2008 might have appeared catastrophic and random due to a rear and extreme nature of the losses. The US Government has stepped in as a guarantor to bail out a number of institutions at the time to prevent the economy from further collapse. In this paper we use the truncated version of the St. Petersburg gamble to argue that extreme and rear losses are actually part of the probability distribution of the financial institutions' risk taking behavior. Further, these long-tailed risks appear to be known to the investors and priced accordingly. Investors appear to both realize the limited ability of the financial institutions to make full payment in case of extremely rear and huge losses and count on the implicit government bail out of the “too large to fail” institutions. The nature and the value of these risks, though, appears to be either ignored or underpriced by the guarantor.

A vivid example of such behavior is a bankruptcy case of the Lehman Brothers. Lehman Brothers was the fourth largest US investment bank at the time of the collapse with \$639 billion in assets and \$619 billion in debt. It was the largest bankruptcy in the US history. Lehman Brothers filed for bankruptcy on 15, 2008. The news that the bank will not be bailed out by the government lead to a massive erosion of global equity with the estimated loss close to \$10 trillion in the market capital over the following month. We would argue that the implicit government guarantee was priced in by the investors and the news of its absence lead to the market's re-pricing of the expected values of the payouts. The investors truncated the value of possible payouts at a lower limit available just from the financial institutions. The investments were re-priced based on the payouts without the additional capital that was implicitly available from the guarantor prior to the collapse of Lehman Brothers. This re-pricing of the value of the possible payouts lead to the huge ripple effect in the global equity markets post-bankruptcy of the Lehman Brothers.

In this paper we build a truncated version of the St. Petersburg gamble to demonstrate that the long-tail risk of the financial institutions is in fact priced in by both sellers and investors who extract profits from the underpricing of the explicit insurance of the large losses by a guarantor. Understanding the non-random and non-catastrophic nature of the long-tailed risk taking behavior would allow for better pricing of the insurance premiums of the guarantor's services and would be a step toward more stable financial markets.

Alan Greenspan famously testified to an error in his thinking, stating, "I made a mistake in presuming that the self-interests of organizations, specifically banks and others, were such as that they were best capable of protecting their own shareholders and their equity in the firms." However, self-interested organizations with tail risk would be less interested in avoiding those losses not borne by their shareholders. Income can be captured by seeking tail risk limited liability firms that can pass the infrequent but large losses onto their unsuspecting creditors and the remaining society.

A post crisis example of a self-interested organization with hidden tail risk is the futures broker dealer, MF Global. In 2010 it made heavily levered investments in Italian, Spanish and other European sovereign bonds maturing in 2012. The firm attempted to profit on the spread between the yield on the sovereign bonds and its payment to creditors. Whether or not the risk was objectively a long-tail risk, MF Global's executives certainly perceived that these European sovereign credits would be extremely unlikely to default. MF Global's creditors in the interbank market appeared to be uninformed about the risk that they bore, were uninsured and ultimately bore potential tail losses. Indeed, even the clients' brokerage accounts, supposedly separated, were ultimately at risk. When a rating agency downgrade revealed extent of the risk to all, the creditors realized the nature of the risk. Their reaction precipitated the firm's demise. If the true risk had never been revealed to its creditors, the profitable arbitrage between the low cost of funds in the inter-bank market and the European sovereign debt market may likely have succeeded. Only the insiders would know the nature of the arbitrage. Indeed, as of the time of the MF Global's bankruptcy, none of the European bonds had defaulted (Azam, Protes, and Craig, 2011).

A famous coin flip model, based on the process underlying the St. Petersburg Paradox gamble, could be used to build intuition about processes that result in long-tailed outcomes. St. Petersburg Paradox gamble is a model based on sequential coin flipping where payouts to the gambler grow exponentially, i.e. the gambler receives $\$2^N$ as payout based on the number (N) of the sequential “head” results of flipping a coin. Such game results in highly skewed outcomes, with frequent small payouts to the gamblers, a few medium payouts, and extremely rare, but enormous payouts. Relative to standard normal models, St. Petersburg model outcomes have long tails. The probability density function for a St. Petersburg type game is a power law distribution where the probability of a next sequential “head” outcome is 2^{-N} , (Liebovitch, Larry S. and Daniela Scheurle, 2000). The sample mean and variance of the data drawn from power law distributions are not good predictors of the mean and variance.

Coin flip models, in spite of their limitations, inform by their simplicity, since they are easily grasped. This paper uses the St. Petersburg paradox coin toss gamble as a model to illustrate how self-interested agents could generate fake alpha and illusory risk-adjusted profits. The agents seem to create real excess returns, but do so by not pricing in the long-tail risk and transferring it to the less informed creditors or to their guarantors instead.

II. The Classical and Bounded St. Petersburg Gamble

In the classical St. Petersburg gamble the outcomes of a game are determined by tossing a fair coin until a “tail” occurs. The customer (buyer) pays the lottery operator (seller) a premium to play. In return the buyer receives a payout based upon the sequence of coin tosses. If the first tail occurs on the N^{th} toss, the payout (Q) equals a stakes parameter [X] times 2^N . Through the rest of the paper we will assume $X=\$1$ for simplicity.

$$Q = [X] \cdot 2^N = \$1 \cdot 2^N = 2^N \quad [1]$$

Thus, if the tail occurs on the 1st toss, the buyer receives $2^1 = \$1$, if the tail occurs on the 2nd toss, then the buyer receives $2^2 = \$4$, if the tail occurs on the third toss, the buyer receives $2^3 = \$8$, etc. A St. Petersburg gamble has a high probability of small payouts, a low probability of medium sized payouts, and a vanishingly small probability of extremely large ones. For a fair coin, the probability of a head or a tail outcome for each toss is the same and is equal to $\frac{1}{2}$. The probability of the tail on the 1st toss is $\frac{1}{2}$, probability of the tail occurring on the second toss is $\frac{1}{2} \cdot \frac{1}{2} = \frac{1}{4}$, probability of the tail occurring on the third toss is $\frac{1}{2} \cdot \frac{1}{2} \cdot \frac{1}{2} = \frac{1}{8}$, etc. Probability of a “tail” outcome occurring on the N^{th} toss is therefore given by 2^{-N} .

The expected probability weighted value of such a gamble to the customer (buyer) is arbitrarily large and is given by the following formula:

$$E(V) = \sum_{N=1}^{\infty} P \cdot 2^N = \sum_{N=1}^{\infty} \frac{1}{2^N} \cdot 2^N = \infty \quad [2]$$

Since potential customers (buyers) would be willing to pay only a limited sum to play the lottery even with such a large expected payoff value on one hand, and no sellers could credibly offer to pay unlimited sums, on the other hand, the classical St. Petersburg gamble cannot exist. It has been suggested as a popular solution to the St. Petersburg paradox that both the sellers and

the buyer realize the limited nature of the potential payoffs for the gamble and tend to equate extremely small probabilities to zero, the players would price the gamble accordingly, i.e. the truncated form of the St. Petersburg coin flipping model. Practical experiments have shown that players would be willing to pay, on average, about \$15 per game. There is a vast literature on the St. Petersburg paradox, reviewed elsewhere (Martin, 2008; Samuelson, 1977). This paper appropriates the coin flip model in a truncated form.

In a truncated version of the St. Petersburg gamble used in this paper the number of coin tosses is limited to a maximum number N^{\max} , that is determined based on the maximum amount of funds available for each player from the firm conducting the gamble. Each gamble ends on the toss in which a first “tail” occurs. If no toss results in a tail the truncated version of the game ends on N^{\max} toss of the coin. The payout to each player, Q , equals 2^N , where $N \leq N^{\max}$. The maximum payout the player can receive from the gamble is therefore $Q^{\max} = \$1 \cdot 2^{N^{\max}}$. If the buyer knows that the seller can pay a maximum of \$1,024, the buyer realizes that the game will end at the maximum of 10 consecutive head tosses even if the tail outcome never occurs (maximum payout = $\$1 \cdot 2^{N^{\max}} = \$1 \cdot 2^{10} = \$1,024$). The expected value of the gamble to the buyer in this case would be \$10 and more generally given by the following formula:

$$E(V_{truncated_gamble}) = \sum_{N=1}^{N^{\max}} \frac{1}{2^{N^{\max}}} \cdot 2^N = N^{\max} \quad [3]$$

In this paper we are applying the bounded St. Petersburg gamble to the firm that has implicit assurance from the independent entity to make payout to the players in case of extremely rare but high values of consecutive “head” coin tosses. The maximum payout offered by the firm, $Q^{\text{firm}} = \$1 \cdot 2^{N^{\text{firm}}}$, is less than $Q^{\max} = \$1 \cdot 2^{N^{\max}}$, that is offered to the buyer. A guarantor with deeper pockets covers the very rare, but huge tail losses. That is a guarantor covers payouts exceeding Q^{firm} up to a maximum of Q^{\max} . An example of such guarantor would be implicit government bailout of “too big to fail” banks. The expected value of the gamble with limited resources available to the seller-firm and with explicit or implicit guarantor stepping in for the rear extreme payouts would be given by:

$$E(V_{truncated_gamble_with_guarantor}) = \sum_{N=1}^{N^{\text{firm}}} \frac{1}{2^N} \cdot 2^N + \sum_{N^{\text{firm}}+1}^{N^{\max}} \frac{1}{2^N} \cdot 2^N = N^{\max} \quad [4]$$

The game described is a zero sum game among three parties if the gamble is priced based on its full expected value with the firm and the guarantor sharing the premium paid by the players. In such a case there would be no real excess returns to be earned. However, the gamble can potentially generate false alpha for both the seller-firm and buyer-players, at the expense of the guarantor, if the guarantor underprices the value of the tail losses. The guarantor would be willing to accept the lower premium for its role if the actual probability of tail losses is hidden or ignored. The rare losses, when they do occur, can appear to the guarantor to be like being hit by a random bolt of lightning.

If the guarantor undercharges for the tail risk, the seller-firm can offer gambles to the

buyer-players at discount compared to the actual expected value of the gamble but above the seller-firm's expected losses. The maximum number of consecutive tosses in the lottery equals N^{\max} , with the maximum payout, $Q^{\max} = \$1 \cdot 2^{N^{\max}}$. N^{firm} equals the maximum number of consecutive tosses before the seller-firm's funds, Q^{firm} , are exhausted. $Q^{\text{firm}} = \$1 \cdot 2^{N^{\text{firm}}}$.

The expected value of payout for the seller-firm equals $(\$1 \cdot N^{\text{firm}})$. The expected value of the seller-firm payout to the players, in dollars, equals:

$$E(V_{\text{of_payout_by_seller-firm}}) = \sum_{N=1}^{N^{\text{firm}}} \frac{1}{2^N} \cdot 2^N = N^{\text{firm}} \quad [5]$$

The payout occurs on the N^{firm} toss whether it is a tail, in which case the seller's funds were just exhausted, or a head, in which case the gamble continues and the guarantor must make up for the further additional losses.

The guarantors' expected loss for each game equals $\$1 \cdot (N^{\max} - N^{\text{firm}})$, the difference between the buyers' expected gain and the sellers' expected loss. The game creates false alpha for both the seller-firm and the buyer-players if the guarantor charges an insurance premium less than $\$1 \cdot (N^{\max} - N^{\text{firm}})$.

$$E(V_{\text{payout_by_guarantor}}) = \sum_{N^{\text{firm}}+1}^{N^{\max}} \frac{1}{2^N} \cdot 2^N - \sum_{N=1}^{N^{\text{firm}}} \frac{1}{2^N} \cdot 2^N = N^{\max} - N^{\text{firm}} \quad [6]$$

Why would guarantors underprice their exposure to long-tailed losses? The chance that the number of consecutive head tosses would require a payout greater than the seller-firm's funds is very small, less than $1/N^{\text{firm}}$. Continuing with the example of maximum funds available to the seller-firm of $2^{10} = \$1,024$, the probability of the guarantor having to step in is $1/2^{10} = 0.00098$. If we assume that a new gamble takes place on monthly bases, the probability of the guarantor having to step in is once in about 85 years. In strictly private markets, the seller-firm's guarantor may underprice tail risk because of information asymmetry about the chance of the extremely rare losses. They may also exhibit disaster myopia - the human tendency to act as if extremely rare outcomes have a zero chance of occurring (Kahneman and Tversky, 1979). The guarantee may be either implicit or explicit. In the presence of substantial negative externalities associated with failure of seller-firm, the too-big-to-fail model, government may socialize extremely rare but huge losses of the private market with long-tail risk.

The following Table I outlines the numerical example with stake parameter $X = \$1$. It shows the probability of the "tail" outcome occurring on the N^{th} coin toss, the payout that will be made in each of the scenarios and the frequency of that outcome. We assume that a new gamble takes place on monthly bases and that the seller-firm has resources to make a maximum payout of $\$1,024$ per gamble. This means that the seller-firm exhausts its resources if the tail outcome does not occur at least until the 10^{th} coin toss. If the tail outcome does not occur on the 10^{th} coin toss, the guarantor will have to step in and make the payout to the player. Later in the paper we also assume that the guarantor can make a maximum payout of $\$32,768 (=2^{15})$, i.e. the gamble continues only to a maximum of 15 coin tosses. This scenario implies $E(V)$ to the player is $\$15$ for each month gamble, and $E(V)$ of payouts that can be made by the seller-firm each month is

\$10. $E(V)$ of the guarantor's payouts is, therefore, \$5 for each month gamble. We use an example with maximum payout from the guarantor of $Q=2^{15}$ (i.e. $E(V) = \$15$) because this is in line with empirical studies of St. Petersburg gamble where players are willing to pay, on average, \$15 to \$20 to enter the game.

Table I

Summary of the Probability Distribution and the Payout Amounts for the Coin Flip Model for up to the Assumed Maximum Capital Available from the Seller-Firm $Q^{\text{firm}} = 2^{10} = \$1,024$ and Assumed Maximum Capital Available from the Guarantor $Q^{\text{max}} = 2^{15} = \$32,768$

1st tail occurs on a toss # N	Probability of the 1st tail outcome occurring on a toss # N = $1/2^N$	Payout amount, $\$1*2^N$	Expected frequency of occurrence assuming new gamble starts on annual bases; once in ...	
1	0.50000	\$ 2	1 year	Payouts that can be covered by the seller -firm
2	0.25000	\$ 4	2 years	
3	0.12500	\$ 8	4 years	
4	0.06250	\$ 16	8 years	
5	0.03125	\$ 32	16 years	
6	0.01563	\$ 64	32 years	
7	0.00781	\$ 128	64 years	
8	0.00391	\$ 256	128 years	
9	0.00195	\$ 512	256 years	
10	0.00098	\$ 1,024	512 years	max # of tosses and \$ payout available from the seller-firm
11	0.00049	\$ 2,048	1,024 years	Guarantor will have to step in to make these payouts (and higher)
12	0.00024	\$ 4,096	2,048 years	
13	0.00012	\$ 8,192	4,096 years	
14	0.00006	\$ 16,384	8,192 years	
15	0.00003	\$ 32,768	16,384 years	

III. Example: Bank Loans with Long-Tailed Risks

In this section we use the described above bounded St. Petersburg gamble with implicit or explicit guarantor (i.e. FDIC and the government) to create a simple models of a rudimentary bank. We show that the agents capture false alpha by externalizing the cost of tail risk to the guarantor when highly probable small gains are combined with rare enormous losses.

A rudimentary bank that invests in risky loans with long-tailed outcomes can be modeled by the above bounded version of the St. Petersburg gamble. The bank finances these risky loans with a combination of owners' equity capital and depositors' funds. The bank's equity owners are tantamount to the seller-firm. Their maximum funds for making a payout equal their invested equity, Q^{firm} . The depositors serve as guarantors for losses exceeding the equity of Q^{firm} , up to a maximum of the bank's loans, equal to Q^{max} . The bank's loan portfolio serves as an aggregate St. Petersburg gamble buyer. The loan portfolio pays a default premium to the equity owners. The defaults are the gamble payouts.

The bank's portfolio of loans experiences losses according to the St. Petersburg distribution. The portfolio experiences defaults in the rare event of extremely adverse economic conditions (Coval, Joshua, Jurek, Stafford, 2009). Diversification of extremely long-tailed gambles can increase risk, such as St. Petersburg paradox (Ibragim, 2005). Each period a single

series of coin flips takes place. The total loss each period on the portfolio equals $\$1 \cdot 2^N$ (stake parameter set to equal \$1). Thus the default or total payout equals \$1·2 for a tail on the first toss, \$1·4 on the second, \$1·8 on the third, etc. The bank's loan portfolio yields risk-free rate of interest plus the default premiums charged by the bank.

The depositors guarantee the tail risk. Their funds cover any extreme losses not covered by the equity owners' capital. In a world of perfect information, the depositors would charge a correct premium for the potential default on their deposits. However, if the bank's depositors know less about the tail risk than the bank's risk management, they may accept an incorrect risk premium. The following model considers the case in which depositors, either due to informational asymmetry or to disaster myopia, charge too low a risk premium. Depositors effectively subsidize tail risk loans if they receive a risk premium insufficient for the risk beard.

Depositors accept a risk-free rate of return on their deposits. With perfect information, the depositors could accurately assess and price the total risk. Here, the bank's retail depositors rely on the bank's misleadingly superior judgment of the risk. The bank's wholesale depositors, such as money market funds, rely on credit ratings that underestimate tail risk as well. Given the relative infrequency of banks' bankruptcies, both types of depositors may find it difficult to imagine true extent of potential losses and so feel safe (Slovic, Fischhoff, Lichtenstein, Corrigan, 1977).

The bank's equity owners receive the risk-free rate of return and the entire default premiums on the bank's loan portfolio. The bank's equity owners bear only those portfolio losses that do not exceed size of their equity investment, while the bank's depositors bear those losses that do.

In an illustrative numerical example, consider the following bank balance sheet. To simplify the example, we use numbers proportional to 2^N , i.e. equity holder contributes a capital of $\$2^{10} = \$1,024$, total assets equal $\$32,768$ (or $\$2^{15}$). Deposits equal the difference between assets and equity. In this example, the bank's equity covers losses up to 10 tosses ($N^{firm} = 10$ tosses) since the equity owners' liability is limited to their equity investment. The depositors cover the very rare losses that occur if there are 11 to 15 tosses ($N^{max} = 15$).

Table II

Example of Bank's Balance Sheet

Based on Truncated St. Petersburg Gamble with Guarantor, where

Bank is referred to as bank-seller, equity capital represents investment made by equity-buyers, depositors are insured by FDIC and act as guarantors.

Balance Sheet			
Assets		Liabilites + Equity	
Loan Portfolio	\$ 32,768 = 2^{15}	Deposits	\$ 31,744
		Equity	\$ 1,024 = 2^{10}
Total	\$ 32,768 = 2^{15}	Total	\$ 32,768 = 2^{15}

If the bank's assets lose \$2,048 million in value ($\$2^{11} = \$2,048$, equivalent to 11 tosses), the bank exhausts \$1,024 million equity, and the depositors lose the difference, \$1,024 million. The bank ceases to exist. In the simulation example, we assume that failed bank's equity owners can continue by capitalizing a new bank with an equity investment of \$1,024 and attracting new depositors and borrowers.

The bank maintains a constant equity capital ratio (equity/total assets). In this example it equals $(\$2^{15}) \div (\$2^{10})$ or 3.125%. The bank distributes all gains, either as dividends or as repurchases, to its owners. Once paid, these funds are off the table and not available to cover losses. As long as the bank's equity capital remains positive, it replaces all losses by raising new equity capital. In the case of insolvency, the depositors cover all losses exceeding the bank's equity.

Each period, the defaults are determined by a random process modeled by the coin toss. Each period, the bank receives a premium, Π , on its loan portfolio. The premium is greater than its expected loss of \$10 (N^{firm}) so that it earns a profit. At the same time the premium is less than the expected loss on the entire portfolio of \$15 (N^{max}).

The model concentrates on insolvency issues. There are no bank runs. The tosses each period occur instantaneously, so depositors cannot anticipate their outcomes. Everyone is in the dark concerning the outcome of the coin tosses in any given period until the sequence is completed. In addition, depositors do not use a negative outcome in the previous period as a signal to liquidate. The underlying random process does not change from period to period and probabilities of default do not change.

The bank's owners generate false alpha from the imperfect information on the part of the depositors and their limited liability for losses. Only if the cost of the deposits to the bank includes a premium sufficient to compensate for the tail risk would the owners' expected profits vanish.

Governments may socialize depositors' losses to mitigate the external costs resulting from financial failure by providing explicit guarantees, such as FDIC insurance. Depositors, who are unable to distinguish between institutions with and without tail risk, would demand high risk premiums on all deposit. This can create a "lemons problem" for the banking system where all banks, those with or without tail risk, would need to pay higher risk premiums to attract uninsured depositors (Akerlof, 1970).

Deposit insurance shifts the task of pricing tail risk to the guarantor. Moral hazard occurs when agents do not bear the full cost of their decisions. In this model, moral hazard arises because of asymmetric information about the tail risk of the assets, not because of deposit insurance. The moral hazard occurs whether the deposits are uninsured, implicitly insured, or explicitly insured. Either correct deposit insurance premiums or a correct depositor risk premiums would eliminate the moral hazard (Chan, Shee, Greenbaum, and Thakor, 1992). The insurer, although better informed than most depositors, might still be informatively disadvantaged, unable to see the true risk in the haze of financial reports. In addition, deposit

insurers may be subject to political influences and regulatory capture that can also lead to the underprice deposit insurance (Kane, 2007; Kane, 1995). Alternatively, depositors who understand the risks and who lack explicit guarantees may expect to exert political pressure to force taxpayers guarantee their deposits ex-post. These expectations generate moral hazard as well (Demirgüç-Kunt and Kane, 2002).

The above model agrees with Nicholas Taleb's observation about bankers.

“If they look conservative, it's only because their loans go bust on rare, very rare occasions. There is no way to gauge the effectiveness of their lending activity by observing it over a day, a week, a month, or ... even a century! . . . They are not conservative at all; just phenomenally skilled at self-deception by burying the possibility of a large, devastating loss under the rug.” (Taleb, 2007).

If higher risk investments yield higher expected returns, raising low risk money and investing it at higher risk yields positive expected spreads. Creating profitable spreads from investments with long-tailed negative payouts distributions takes advantage of imperfect information about very small probability outcomes (Acharya, Thomas Cooley, Matthew Richardson, and Ingo Walter, 2009). For example, suppose agents in a bank discover an investing opportunity with an attractive spread that is in fact based upon unknown tail risks. The agents do not need to personally believe they are accepting the long-tailed risk. They merely need to spot the spread between their cost of funds and the expected return on apparently safe assets with tail risk.

The bank's risk managers might underestimate the expected losses of the long-tailed risks. They may use measures based upon past historical events and underestimate long-tail risk by applying normal distribution models (Powell, 2008). Moreover, they may lack internal authority. As a result, risk management may charge the unit an insufficient risk premium. The unit appears to earn a spread. Its employees receive generous compensation based upon the units' apparent performance. Internally, firms over allocate capital to units with the underpriced risk. Moreover, such compensation systems can motivate trading units to create new long-tailed contracts to trade. A Gresham's law-like outcome results. Risky long-tailed trading replaces trading with more normal distribution of losses.

IV. Example: Credit Default Swaps

As another example the coin flip model can represent a derivatives trading unit that sells credit default swaps. The trading unit sells credit default swaps, receives the premiums, and covers all losses on the swaps up to a point. Since selling long-tailed gambles can be profitable for extended time periods, tying trader compensation to current income encourages taking risks of enormous losses that have very small probability. These losses are likely to occur at very long time intervals. The firm in which the trading unit operates serves as the guarantor. Back up guarantors are the firm's creditors, if the unit's losses exceed the entire firm's equity, and the greater society for too-big-to-fail firms.

The unit's creditors may understand the exposure to long-tailed outcomes on their debt

and willingly insure the risk in exchange for a premium. Alternatively, certain investors will pay the premiums for positive exposure to long-tailed payouts and advocate hedging or speculating on tail risk (Pia, 2009). These customers credibly anticipate very large payments to be guaranteed by the larger firm or by the larger society, if bankruptcy of credit default trading unit would impose severe external social costs (Taleb, 2007).

V. Simulation of St. Petersburg Gambles

A bounded St. Petersburg type lottery can simulate the above examples. We will present simulation using bank as an example. Depositors and FDIC insurance acting as explicit guarantors. The limit covered by the seller-bank, Q^{firm} , equals the bank's equity capital. The upper limit of the gamble, Q^{max} , equals the bank's total assets and the amount covered by the FDIC insurance. A guarantor covers the portion of any payouts exceeding Q^{firm} .

The following assumptions are made for simplicity of presentation.

- New gamble takes place over one time period. Each time period is set to be one year. Each annual gamble is independent of the previous one.
- Q^{firm} is constant for each time period. At the end of each period, all required payouts are made, all premiums for the next period are collected from the equity holders.
- Whenever the premiums collected exceeds the payouts, the difference is distributed as a dividend.
- Whenever the payouts exceed the premiums collected, the guarantor covers the difference above Q^{firm} up to Q^{max} , and bank recapitalizes.
- The guarantor's risk premium is zero. Assuming a zero premium does not affect the qualitative results of the simulation. Insufficient premium for the level of risk taken will generate similar outcomes of the simulation. Insufficient premiums charged by the guarantors permit false alpha to exist for the equity investors.
- The risk free rate is set to zero, so that returns in the simulation are in excess of the risk free rate.
- Recapitalization and bankruptcy are costless. The sellers can raise new capital, form a new bank, and resume. The equity investors' outside capital is shielded by limited liability.
- The bank's equity covers losses up to 10 tosses ($N^{\text{firm}} = 10$ tosses). The guarantor cover the very rare losses that occur, up to 15 tosses ($N^{\text{max}} = 15$).

Each year a fair coin is tossed until a 'tail' occurs up to a maximum of 15 tosses. The stakes parameter 'X' equals \$1. Each year the sellers' payout, or loss, equals $Q = \$1 \cdot 2^N$ dollars.

N equals the number of consecutive coin tosses until the first “tail” occurs. The seller’s maximum loss occurs at $N^{\text{firm}} = 10$ tosses, for a maximum amount that will be paid by bank’s equity holders, Q^{firm} , equal to $\$2^{10}$ (\$1,024). The maximum total number of tosses is limited $N^{\text{max}} = 15$ tosses for a maximum payout that can be made by the guarantor, Q^{max} , equal to $\$2^{15}$ (\$32,768).

The guarantor’s maximum payment equals $Q^{\text{max}} - Q^{\text{firm}}$ ($\$2^{N^{\text{max}}} - \$2^{N^{\text{firm}}}$). If the first head occurs on the 10th toss, the bank-seller makes its maximum payout of $\$2^{10}$ and recapitalizes, but the guarantor suffers no losses. If the first head occurs on the 11th or higher toss, the bank-seller also pays $\$2^{10}$ and recapitalizes. The guarantor makes any additional payouts up to its limit of $\$2^{15}$. The guarantor’s maximum payout equals $\$31,744$ ($\$2^{15} - \2^{10}). This payout occurs whenever the first tail does not occur on the first 14 tosses. The maximum is paid if the 15th toss is either the first tail or another head, the game always ends on the 15th coin toss because the guarantor’s funds are exhausted as well.

The probability of N heads occurring in a row is given by $2^{-(N-1)}$. For $N=10$, this probability is 0.195%. Its reciprocal, 2^{10} , equals the expected time to occurrence, which in our example would be equal to 512 years. Thus, the probability that the guarantor must make any payment is less than the risk of a 100-year flood.

The expected value, $E(V^{\text{firm}})$ of each annual payout for the sellers equals \$10, but for the buyer the expected value of the gamble equals $E(V^{\text{max}})$, or \$15, using equations [2] and [3]. While the payout covered by the guarantor might seem unforeseeable by its rarity, the expected value of the premium for the covered losses, $E(V^{\text{max}}) - E(V^{\text{firm}})$, is \$5 each year in this example. Only if the guarantor charges an insurance premium $[\Phi]$ of \$5 per year, there would be no false alpha. In our analysis the insurance premium charged by the guarantor is set to zero. The main interest of this paper is to investigate the excess returns that market participant can capture when the guarantor fails to charge the sufficient insurance premium for acting as such. Setting the insurance premium to zero leads to no loss of generality of the simulation outcomes.

If the bank-seller and the equity-buyers do understand the nature and the level of the risk insured by the guarantor, they would be willing to split the amount of the full insurance premium of the gamble, $[\Phi] = \$5$ per month. The actual premium, P , paid by the equity-buyers above what the value of the gamble that the bank would be able to pay out, $E(V^{\text{firm}})$, would determine the relative share of the false alpha captured by the equity-buyers and bank-seller. The higher the P , the greater the share captured by the bank-seller. For the simulation example, we assume that the bank and equity holders split the full insurance premium of the gamble, $[\Phi]$, equally. The monthly premium, $[II]$ paid by the equity-buyers to bank-seller above the $E(V^{\text{firm}})$ that the bank is able to payout, is arbitrarily set at \$2.50 - half way between the \$15 (N^{max}) and \$10 (N^{firm}). Hence, the total bank-seller would charge equity-buyers to enter the gamble would be

$$\text{Total Charge} = E(V^{\text{firm}}) + II = \$10 + \$2.50 = \$12.50 \quad [7]$$

VI. Results of the Simulation

The following reports the results of coin toss simulations using the geometric

distribution. The probability of a head on each coin toss equals 0.5. The results of 10 simulations are shown in Table 3. Each simulation consists of 1 independent gamble per bank for 100 banks over 100-year time period (10,000 gambles per simulation). Total of 10 simulations are ran.

In the simulations both bank-sellers and their equity-buyers experience positive earnings as a group over a long period. The buyers have much greater variability of outcomes than the firms. Out of 10 century-long simulations the bank-sellers have profited in every one of the simulations, while the buyers profited in 7 out of 10 simulations. Over the 10 century-long simulations, though, both bank-seller and equity-buyers has positive capital gain (average of \$1.64 per gamble for the banks and \$1.89 per gamble for the equity-buyers).

In all 10 century-long simulations, the guarantor had to step in with the bailout. On average, there are 9 banks requiring bail out per century out of 100 banks. The infrequency of failure maintains the appearance of low risk. The average amount of each bailout by the guarantor was \$3,883. The average payout per gamble to the equity-buyers was \$14.39, which is close to the E(V) of \$15 per gamble that is truncated at a maximum of 15 coin tosses.

Table III. Summary of the Payouts, Gains and Losses, in dollars
10 Simulations, each Simulation Runs Annual Gambles for 100 Banks over 100 Years

Each Simulation Runs Annual Gambles for 100 Banks over 100 Years

Simulation #	Avg. payout per game, per player	# of bailouts per simulation	Avg. Paid by Guarantor per bailout	Avg. Net Gains (Losses) by Players per game	Avg. Net Gains (Losses) by Bank per game
1	\$ 14.49	7	\$ 5,120	\$ 1.99	\$ 1.60
2	\$ 16.44	18	\$ 2,844	\$ 3.94	\$ 1.18
3	\$ 11.99	7	\$ 1,609	\$ (0.51)	\$ 1.63
4	\$ 13.97	10	\$ 3,482	\$ 1.47	\$ 2.01
5	\$ 18.42	10	\$ 7,578	\$ 5.92	\$ 1.66
6	\$ 15.75	9	\$ 5,120	\$ 3.25	\$ 1.36
7	\$ 11.81	6	\$ 1,707	\$ (0.69)	\$ 1.71
8	\$ 12.29	5	\$ 3,891	\$ (0.21)	\$ 2.15
9	\$ 13.62	6	\$ 4,096	\$ 1.12	\$ 1.34
10	\$ 15.14	13	\$ 3,387	\$ 2.64	\$ 1.76
Average for 10 simulations	\$ 14.39	9	\$ 3,883	\$ 1.89	\$ 1.64

The returns to both bank-sellers and equity-buyers were covered by the guarantor and were about evenly split between the two (13.1% and 15.1%, respectively, for the total of 28.2% that came from the guarantor's losses), see Table IV for the summary of all 10 simulations.

Table IV. Summary of the Returns, Gains and Losses, in percent
10 Simulations, each Simulation Runs Annual Gambles for 100 Banks over 100 Years

Each Simulation Runs Annual Gambles for 100 Banks over 100 Years

Simulation #	Avg. R to bank per game	Avg. R to players per game	R to players paid (collected) by bank per year	R to players paid by guarantor
1	12.8%	15.9%	-12.8%	28.6%
2	9.4%	31.6%	-9.4%	40.8%
3	13.1%	-4.0%	-13.1%	8.9%
4	16.1%	11.7%	-16.1%	27.8%
5	13.3%	47.3%	-13.3%	60.5%
6	10.9%	26.0%	-10.9%	36.8%
7	13.7%	-5.5%	-13.7%	8.1%
8	17.2%	-1.7%	-17.2%	15.5%
9	10.7%	8.9%	-10.7%	19.6%
10	14.1%	21.1%	-14.1%	35.1%
Average for 10 simulations	13.1%	15.1%	-13.1%	28.2%

The bank-seller's profit equals the difference between total charged from equity-buyers, income from investment assets, payouts to equity-buyers, payments to depositors and insurance premium to the guarantor.

$$\text{Bank-Seller's Profit} = E(V^{firm}) + II + Assets \cdot I - Payouts - Deposits \cdot R_f - \Phi \quad [8]$$

For the purpose of the simulation and without loss for general outcomes, we have set I (interest earned on invested assets by the bank) and R_f (risk free rate paid to depositors) equal to zero. The main interest of this analysis is to investigate the results of the scenario where the guarantor fails to charge sufficient insurance premium Φ for bearing the long-tailed risk. The bank-seller and the equity-buyers split the insurance premium Φ and capture the false alphas resulting from it. The bank-seller's profit becomes total charged from equity-buyers less payouts made to them.

$$\text{Bank-Seller's Profit} = E(V^{firm}) + II - Payouts \quad [9]$$

The gains to the bank-seller and their equity-buyers equal the guarantor's losses. Bank-seller expected value of the profits is equal to the premium, II , charged above the $E(V^{firm})$, the maximum amount that the bank-seller can payout (the expected value of the Payouts made by the bank over the log-run is equal to $E(V^{firm})$). The equity-buyers capture the profits above the expected value of the gamble, $E(V^{max})$, equal to $(\Phi - II)$, the value of the insurance premium provided but not charged by the guarantor, less the premium paid to the bank-seller. The equity-buyers' earnings are much more volatile. The division of earnings between the buyer and the seller depends upon II , the premium charged by the bank-seller above the value of the payouts that it can make. It would be set by the competitive conditions at the market. In the simulation II is assumed to equal \$2.50 for expositional purposes.

Tables V and VI report selective gambles results from the simulations for two random

banks, #1 and #2, over 100 years of annual gambles. Bank #1 has not experienced bailout scenario, while Bank #2 had been bailed out in Year #13. In both examples Banks suffered Net Losses. For Bank #1, Average Payout to the equity-buyers is \$14.16, which is equal to the average Profit of \$1.66 (\$14.16 - \$12.50). Banks report the average Net Loss of \$1.66, i.e. the gamble is a zero-sum game between the bank-seller and the equity-buyer when guarantor does not step in with the bailout. For Bank # 2, one bailout has occurred in year 13. For that year Total Payout was \$4,096, Bank #2 has covered \$1,024 of it, and the guarantor has covered the rest of it, \$3,072. The averages over 100 years reflect that the gamble was a zero sum game between the bank-seller, equity-buyers and the guarantor. Equity-buyers have received a total of \$6,420 over the century (\$64.20 average payout * 100 years), they have made the total payment of \$1,250 (\$12.50 total charge per gamble * 100 annual gambles), which leaves the equity-buyers with the profit of \$5,170. Bank #2 has paid \$2,098 of it (\$20.98 average bank loss * 100 years), and the rest was covered by the guarantor, \$3,072.

Table V

Simulation for Bank #1 over 100 years (no bailout has occurred)

Year #	Random Probability that N consecutive toss has 1st tail	1st tail is on the toss # N	Payout per Game, \$	Bailout: Y or N	Bailout Amount = Payout - \$1,024 Paid by Bank	Net Gains (Losses) by Bank = \$12.50 - Payout
Average		2.2	\$ 14.16	0	\$ -	\$ (1.66)
1	0.5000	1	2	N	0	10.5
2	0.2500	2	4	N	0	8.5
...
13	0.5000	1	2	N	0	10.5
14	0.2500	2	4	N	0	8.5
...
94	0.1250	3	8	N	0	4.5
95	0.1250	3	8	N	0	4.5
...
99	0.5000	1	2	N	0	10.5
100	0.5000	1	2	N	0	10.5

Table VI

Simulation for Bank #2 over 100 years (bailout has occurred in Year # 13)

Year #	Random Probability that N consecutive toss has 1st tail	1st tail is on the toss # N	Payout per Game, \$	Bailout: Y or N	Bailout Amount = Payout - \$1,024 Paid by Bank	Net Gains (Losses) by Bank = \$12.50 - Payout
Average		2.1	\$ 64.20	1	\$ 3,072	\$ (20.98)
1	0.5000	1	2	N	0	10.5
2	0.2500	2	4	N	0	8.5
...
13	0.0002	12	4096	Y	3072	-1011.5
14	0.2500	2	4	N	0	8.5
...
94	0.5000	1	2	N	0	10.5
95	0.0010	10	1024	N	0	-1011.5
...
99	0.5000	1	2	N	0	10.5
100	0.5000	1	2	N	0	10.5

While each individual lottery appears risky, diversification radically reduces the risk. A portfolio diversified across all gambles and including both the buyers and the sellers yields positive returns with little variation. This can be inferred from Tables III and IV above. Such an investment strategy consists of owning all seller-banks and investing all the equity for those banks. The appropriately diversified investors can easily capture the close to the average false alpha with minimal risk.

Hedging strategies could be an alternative method to reduce the risk of collecting the false alpha. Investors with sufficiently precise information about the market could invest in equal shares of each seller and each buyer. In the case of the banks' loan portfolio, a simple hedge consists of being long the bank's stock and being short the bank's portfolio of securities by using a credit default swap.

For each gamble, if the investor is long in both the seller and the buyer positions, all negative returns would be eliminated, since the buyer's gains equal the seller's losses plus payouts by the guarantor. There are some games in which the hedge results in zero returns over the century, but on average, equity-buyers losses are eliminated through diversification. Table VII reports summary results of diversification strategies for the 10 simulations. Average returns on the hedging strategies that invest into both bank-sellers and equity-buyers are higher than for investment into banks or equity holders separately. The hedged investor is better positioned to capture the gains from the guarantor.

Table VII. Returns on Hedging Strategies for 10 Simulations
Each simulation is the average for 100 banks over 100 years

Simulation #	R on 50/50 Bank/Equity Hedge	R on 40/60 Bank/Equity Hedge	R on 60/40 Bank/Equity Hedge
1	22.5%	23.9%	21.1%
2	34.0%	38.6%	29.4%
3	9.0%	7.2%	10.9%
4	59.0%	70.5%	47.4%
5	30.3%	34.3%	26.4%
6	16.8%	16.8%	16.8%
7	19.7%	21.9%	17.4%
8	26.6%	29.7%	23.6%
9	16.0%	16.6%	15.4%
10	25.4%	28.4%	22.4%
Average for 10 simulations	25.9%	28.8%	23.1%

VII. Discussion

The model of a zero-sum game based on this gamble is obviously an unrealistic depiction of actual investment behavior in complex environments. As with any model, it utilizes simplifications and assumptions not descriptive of real markets. As is common in financial models, there are no transactions costs in the model. The participants face a constant and independent probability distribution for each gamble and a constant real interest rate. The herd behavior by depositors that creates a liquidity crisis through bank runs and illiquidity is absent. There are no fire sales, creating unexpected losses. Insolvency is caused by a random collapse in the external value of the assets, not bank runs. Further, raising new debt and new equity in the market is frictionless and always possible, even after the experience of large losses.

A. Leverage

The greater the seller's leverage, the more likely it is that the guarantor, whether private or public, will eventually have to make payouts. More leverage creates greater "false alpha" to be captured. The equity ratio, total equity divided by total assets, measures the bank-seller's leverage. For example, the equity ratio in the above simulation equals $3.125\% [2^{10}/2^{15}]$. This is comparable to the 4% Tier 1 capital requirement in 2003, before the risk-weighted reduction for AAA debt.

Increasing the equity ratio decreases the expected value of the guarantor's payout in each period. In the above example, the expected value of the guarantor's payout is $N^{\max} - N^{\text{firm}}$ and equals \$5 per game per player. Leverage can be reduced by increasing equity capital or by decreasing assets. If equity capital increases to 2^{12} , holding total assets the same, the equity ratio becomes $2^{12}/2^{15} = 12.5\%$. Likewise, decreasing total assets to 2^{13} , and holding equity the same, results in the same equity ratio, $2^{10}/2^{13} = 12.5\%$. In both cases the expected value of the guarantor's payout, $N^{\max} - N^{\text{firm}}$, is reduced to \$3 per game per player. With less leverage, false alpha is decreased, but not eliminated.

Bank-seller's agents have strong incentives to allocate a great deal of effort and talent to disguising the actual level of the expected value of the guarantor's payout, $N^{\max} - N^{\text{firm}}$. In complex regulatory environments, they may disguise their true leverage from auditors, rating agencies, and regulators. One example would be the use of off-balance sheet assets and liabilities of banks. Another is the innovative use of repo transactions to disguise the risk. Accounting practices that overstate value of assets or understate value of liabilities ultimately falsely inflate the equity and disguise the true degree of leverage.

Lowering the protection afforded by limited liability for firms or demanding claw backs of compensation from units within firms, reduces the expected value of the guarantor's payout, $N^{\max} - N^{\text{firm}}$, by effectively increasing N^{firm} . From the end of the Civil War up to the introduction of deposit insurance during the 1930s most U.S. banks operated with double liability provisions. Owners of failing banks not only lost their investment in the banks, but were liable for additional assessments up to the par value of the bank's equity. Evidence suggests that double liability reduced risk taking among banks in the late nineteenth and early twentieth centuries, but was not very effective in reducing the risk of failure during the financial collapse of 1930s. Such provisions would increase effective equity to $2^{N^{\text{firm}}}$ in this model and so would have the effect of decreasing leverage (Grossman, 2001). Double liability was discarded with the advent of deposit insurance.

The guarantor's liability for tail risk can be reduced by requiring such institutions to be financed with contingent long-term debt or preferred stock. A regulator can mandate the conversion of these bonds to equity. Presumably long-term investors in these contingent claims could better assess and monitor tail risk than most depositors. The rates demanded by creditors could reflect the portion of the tail risk they assume. The solvency of the institution can be thus maintained without liquidation of payments by the deposit guarantor. Financial fragility and moral hazard is reduced. N^{firm} is increased. A severe enough shock, modeled here by a very long sequence of "heads" before a "tail", would exhaust the contingent liabilities. This implies that even more tail risk would be priced internally, therefore reducing, but not eliminating, incentives that capture false alpha.

B. Size

The model presented here is scalable. Size, per se, is not an issue in the model. However, when a firm is considered to be "too-big-to-fail", effective leverage and relative amount of implicit guarantee are increased. As a result of the bail out of the "too-big-to-fail" firms some of their equity capital is not at risk, but is preserved. This confers a competitive advantage over their smaller rivals. The "too-big-to-fail" firms are able to pass on more of the tail risk to guarantors or governments. In addition to "too-big-to-fail", politically well-connected firms are more likely to be bailed out than their non-connected peers as well. In our model, being "too-big-to-fail", is similar to having a lower equity capital ratio (Grossman, 2001).

C. Pricing Risk

Bank-sellers and depositors, or their guarantor, can set the insurance premium Φ . A correctly priced Φ eliminates the opportunity for false alpha. To correctly price Φ , the guarantor

must be aware of both the actual tail risk and the degree of financial leverage. In the coin flip model, correctly priced risk means that $\Phi = N^{\max} - N^{\text{firm}}$. Low interest rates on deposits, or low deposit insurance premiums, result in the underpricing of Φ in the bank model. Underpricing of risk occurs if Φ is less than $N^{\max} - N^{\text{firm}}$.

In our model, the premium, Π , charged by the bank-sellers to the equity-buyers determines the relative share of the false alpha captured by buyers and the sellers of the zero sum game, but does not affect its total gains. The size of Π is not relevant to a diversified investor who invests proportionately in both the seller and the buyer, unless it affects the volume of the activity.

Basing unit and management bonuses on a long-term performance could mitigate some of the incentive to seek investments with long-tail risk. However, truly rare events are unlikely to occur during a reasonable measurement period for compensation. Claw-back provisions over a five year period are unlikely to affect the truly long-tailed bets. The expected time to the occurrence of truly small probability events will likely exceed the length of any meaningful measurement period of performance.

VIII. Conclusions

The St. Petersburg coin-flip gamble is an accessible example of a power law distribution. Its simplicity allows us to focus on long-tail risk, ignoring other types of risks. It shows that self-interested agents can extract illusory positive returns when long-tail risk and limited liability are present. Self-interested sellers have little incentive to avoid the risk of tail losses that exceed their own limited liability, but can capture the long-tail risk when less informed creditors, or their guarantors, fail to price it correctly. With long-tail risk the huge losses occur so rarely that short term creditors may act as if their assets are risk free and ignore their exposure to tail risk. This creates an arbitrage opportunity to capture the mispriced value of the long-tail risk. Even though short-term losses are still possible for the outside investors, they should be able reduce any risk with diversification and hedging.

The simple sequential coin toss gamble can serve as an intuitive model of investments with cascade-like risks that result in long-tailed outcomes. The maximum payout of a gamble is limited by the sum of the resources of the game's seller and the resources of any guarantor, explicit or implicit. A seller receives premiums from buyers in exchange for frequent small payouts, rare large payouts, and extremely rare, enormous ones. Even in a zero sum game, buyers and sellers can both extract gains if tail risk is either hidden from or underestimated by the guarantors. The St. Petersburg coin-flip game models aspects of depository institutions' risk taking behavior where depositors and government serve as guarantors of tail risk. Positive expected returns result when agents with limited liability shift tail risk onto external parties due to imperfect information or disaster myopia. The model shows that it is actually in self-interest of the sellers with limited liability to increase leverage and the chance of bankruptcy. It also shows a possibility of creating a hedge by investing into both the bank-sellers and equity-buyers that could, in principle, capture the full value of the external guarantee.

IX. References

- Acharya, V.V., Cooley, T., Richardson, M., & Walter, I. (2009). Manufacturing Tail risk: A Perspective on the Financial Crisis of 2007–09. *Foundations and Trends in Finance*, 4(4), 247-325.
- Akerlof, G. A. (1970). The Market for 'Lemons': Quality Uncertainty and the Market Mechanism. *Quarterly Journal of Economics*, 84(3), 488–500.
- Asli, D-K, & Kane, E. J. (2002). Deposit Insurance Around the Globe: Where Does It Work? *Journal of Economic Perspectives*, 16(2).
- Azam, A., Protess, B., & Craig, S. (2011). A Romance with Risk that Brought on a Panic. *Business Day, The New York Times*, December 12, 2011, 1.
- Chan, Y.S., Greenbaum, S.I., & Thakor, A. V. (1992). Is Fairly Priced Deposit Insurance Possible? *Journal of Finance*, XLVIII (1).
- Coval, J., Jurek, J., & Stafford, E. (2009). The Economics of Structured Finance. *The Journal of Economic Perspectives*, 23(1), 3-25.
- Ehrlich, M., Anandarajan, A., Chou, B. (2009). Structured Investment Vehicles: The Unintended Consequences of Financial Innovation. *Bank Accounting & Finance*, October-November 2009, 29-37.
- Faccio, M. (2009). Differences between Politically Connected and Non-Connected Firms: A Cross Country Analysis. August 2009, SSRN: http://papers.ssrn.com/sol3/papers.cfm?abstract_id=918244
- Fox, J. (2010). Chapter 2: A Random Walk from Fred MacCaulay to Holbrook Working. In: *The Myth of the Rational Market*.
- Greenspan, A. (2008). Congressional Testimony, Hearing of the House Committee on Oversight and Government Reform. October 23, 2008.
- Grossman, R. S. (2001). Double Liability and Bank Risk Taking. *Journal of Money, Credit and Banking*, 33(2), 143-159.
- Ibragimov, R. (2005). Portfolio diversification and value at risk under thick-tailedness. *Harvard University Research*, Discussion Paper # 2086: <http://www.economics.harvard.edu/pub/hier/2005/HIER2086.pdf>
- Kane, E.J. (1995). Three Paradigms for the Role of Capitalization. *Journal of Banking and Finance*, 19, 431-59.
- Kane, E.J. (2007). Basel II: A Contracting Perspective. *Journal of Financial Services Research*, 32, 39-53.
- Khwaja, A. I. & Mian, A. (2005). Do Lenders Favor Politically Connected Firms? Rent Provision in an Emerging Financial Market. *Quarterly Journal of Economics*, 120(4), 1371-1411.
- Liebovitch, L. S. & Scheurle, D. (2000). Two Lessons from Fractals and Chaos. *Complexity*, 5(2), 34-43.
- Martin, R. (2008). The St. Petersburg Paradox, The Stanford Encyclopedia of Philosophy. Edward N. Zalta (ed.), <http://plato.stanford.edu/archives/fall2008/entries/paradox-stpetersburg>
- Powell, R., (2008). Measuring Extreme Financial Risk with Power Laws. *Bank Accounting and Finance*, February-March 2008, 31-35.
- Rajan, R. G. (2010). How Hidden Fractures Still Threaten the World Economy.
- Samuelson, P. A. (1977). St. Petersburg Paradoxes: Defanged, Dissected, and Historically

Described. *Journal of Economic Literature*, 15(1), 24-55.

Sankar, P. (2009). Being prepared: PIMCO guarding against fat-tail events. *Pensions & Investments*, 8/10/2009, Vol. 37, Issue 16, 3-29.

Slovic, P., Fischhoff, B., Lichtenstein, S., & Corrigan, B. (1977). Insuring against Probable Small Losses: Insurance Implications. *The Journal of Risk and Insurance*, 44(2), 237-258.

Taleb, N. (2007). The Black Swan.

Tversky, A. & Kahneman, D. (1973). Availability: A heuristic for judging frequency and probability. *Cognitive Psychology*, 5, 207-232.

The Impact of the Bio-terrorism Act on the Supply Chain and Firm Value

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Abstract

On June 12, 2002, President Bush signed into law the Public Health Security and Bioterrorism Preparedness and Response Act of 2002. The Bioterrorism Act requires domestic firms and importers to register their agribusiness facilities with the U.S. government, to notify Homeland Security prior to shipment of agricultural products, and to keep records on the origination of agricultural inputs and the destination of agricultural outputs. Thus, the Act significantly altered the U.S. regulatory climate for both U.S. and foreign food industry firms who do business in the U.S. We present evidence that the passage of the Bioterrorism Act resulted in an average 3.2% decline in the market value of equity of domestic food industry firms. Cross-sectional analysis suggests that costs are increasing in the diversity of the firms' supply chains. Contrary to the conclusions of prior research, we also find that the Bioterrorism Act does not constitute a non-tariff barrier to Canadian food firms. We base this conclusion on the fact that the negative wealth effects for U.S. firms are similar in magnitude to those previously reported for Canadian firms.

I. Introduction

The Public Health Security and Bioterrorism Preparedness and Response Act of 2002 (hereafter, the Bioterrorism Act or the Act) was signed into federal law by President Bush on June 12, 2002. The Act requires domestic firms and importers to register their facilities with the U.S. government, to notify Homeland Security prior to shipment, and to keep records on the origination of inputs and the destination of outputs. The Act received a considerable amount of attention for several reasons. One, it represented a response by Congress and the White House to the terrorist attack of 9/11/2001. Two, the act was far-reaching and contained five titles that potentially impacted a variety of sectors in the U.S. economy¹. Three, Title III of the Bioterrorism Act provided four provisions that were predicted to substantially alter the cost and revenue structure of food and beverage firms by increasing supply chain costs of importation, processing, handling and record keeping (O'Rourke 2003B). Consistent with higher costs for food industry firms, many food and beverage firms lobbied against the implementation of the Act (Abboud, 2003B). Some analysts viewed the provisions as appropriately balancing potential costs incurred by firms with the U.S. government's desire a safe and secure food supply (Fox 2005; India-West 2010). Finally, some have claimed that the Act sacrifices trade relations for national security concerns because it disadvantages firms outside the U.S. relative to U.S. firms (Boisen 2007).

The passage of the Bioterrorism Act raised at least two basic concerns for U.S. firms. One concern is that the act had a significant negative impact on supply chain costs. If this is

true, it would be helpful to know just how large the effect is. A second concern seems to go in the opposite direction. It has been suggested that the Act created a non-tariff trade barrier for Canadian food firms importing in the U.S. If the Act puts Canadian firms at a cost disadvantage relative to U.S. firms, then we would expect an increase in the revenues and market values of U.S. firms in the food industry. Another possible positive effect of the Act is that added quality and safety assurance, combined with the fact that the demand for food is relatively inelastic, may allow U.S. firms to raise prices.

A better understanding the potential costs and benefits of the legislation can be provided by the examination of characteristics of two very different food industry firms, Green Mountain Coffee and Kroger Company. During the time period of our study, Green Mountain Coffee was a regional Northeast U.S. distributor of fair-trade coffee. Green Mountain is likely to experience lower compliance costs than the average firm in the industry (Coffee Distributing Corporation November 14, 2014). One, Green Mountain already had tight control over their supply chain because their strategy required the provision of assurance to customers that their suppliers were following fair trade practices. Thus, the record keeping requirements of the Act probably did not represent a significant change in their supply chain costs. Two, as a U.S. only firm, the Act may have reduced the competition that could have been provided by Canadian firms.

On the other hand, grocery stores such as Kroger Company are likely to experience negative effects from the Act. Kroger Company spans many states and has thousands of different fresh and processed grocery products that fall under the Act's provisions. Hence, the costs of expanded record keeping and possible border delays (which can cause fresh food to spoil) may imply a more expensive, riskier supply chain and a negative effect on the grocery store's market value.

We are aware of only one study that has considered the impact on U.S. firms (Taylor 2004). Taylor estimated, from survey data, that U.S. and Canadian firms would jointly lose approximately 13 billion dollars each year from increased supply chain costs. Other studies have examined only Canadian firm effects and typically conclude that the Act served as a non-tariff trade barrier. These studies take various approaches to the question including: surveys of management and government officials' opinions about the impact of the Act (Murphy 2004), self-reported survey data on expected supply chain cost increases (Murphy 2004), self-reported survey data on actual cost increases (Ontario Chamber of Commerce 2005, Taylor 2004, MacPherson 2008), and an event study that examined the impact of the act on Canadian food firms (Johnson et al. 2013).

Surveys that attempt to quantify the costs of the Act to Canadian firms have produced varying cost and revenue estimates. The Ontario Chamber of Commerce study (2005) provides an estimate of \$5.25 billion dollars loss to the Canadian economy. Taylor provides a combined estimate of \$10.3 billion per year of lost value to the U.S. and Canadian economies, which represents 2.7% of the total value of 2001 merchandise trade between the two countries. Finally, MacPherson (2008) finds that the Act disrupted supply chains in significant ways such that firms lost revenues and experienced higher costs. Further, MacPherson finds that smaller firms were impacted more heavily than larger firms. MacPherson does not provide an industry or economy wide estimate of the supply chain cost, but concludes that the Act is a non-tariff trade barrier

between the U.S. and Canada because of these costs. Johnson et al (2013) used event study methodology to examine the impact of the Act and found that Canadian firms lost at least 2% of their equity value due to the Act. They conclude that their evidence seems to support the idea that the Act is a non-tariff trade barrier.

In this paper we provide a market-based estimate of the impact of the Bioterrorism Act on publicly traded U.S. food and beverage firms. The study will proceed in a manner similar to previous regulatory event studies. First, we assemble a list of food and beverage firms that are publicly traded firms in the U.S. Then we examine press announcements and the Congressional Record to identify informational events that we think might provide investors with value-relevant information about the content of, and likelihood of passage of the Act. We use the market model to determine normal returns for the firms over the event periods. We then calculate abnormal returns equal to the actual returns minus the normal return predicted by the model. The abnormal returns measure the overall wealth effect of the Bioterrorism Act on the food and beverage industry in the U.S.

Our analysis will provide additional evidence on the merits of the Bioterrorism Act. Our market based approach is useful for at least two reasons. First, it provides investors' assessments of total costs over time, not merely an estimate of losses in a given year. Thus, it reflects expectations of a firm's future ability to adjust operating procedures and minimize the impact of the Act over the long run. Second, it provides evidence that has not originated from the firms themselves. Self-reported information may include a managerial bias since managers may choose to minimize or maximize the reported impact of the Act to suit their own purposes. A market study of the type presented here will reflect investor views of the impact of the Act.

The paper will proceed in a manner similar to previous event studies. Section 2 discusses the Act as it relates to food and beverage firms and presents our hypotheses. Section 3 explains the research design and also describes the sample firms and methodology. The main results are presented in Section 4. Section 5 provides evidence on whether earlier federal legislation in the 1990's also impacted supply chain costs. Section 6 summarizes the analyses and offers conclusions.

II. Overview

This section discusses the prior literature and develops several hypotheses about the impact of the Bioterrorism Act on U.S. food industry firms.

The Bioterrorism act is a multifaceted act that contains five major Titles. Title III, "Protecting Safety and Security of Food and Drug Supply," directly impacts the food and beverage industry. Its four key provisions include: facility registration regulations, regulations requiring prior notice of food imports, administrative detention, and record keeping requirements. The food facility registration title requires all domestic firms and foreign importers to register their facilities with the U.S. government. The prior notice title requires importers to notify Homeland Security prior to shipment of food items. The administrative detention title allows foodstuff that are being imported to be detained if contamination or violation of the rules is suspected. The record keeping title requires food firms to keep records of the origination of

inputs and the destination of outputs. Table I lists the food items covered by the Act. (For additional background, see Food and Drug Administration 2012, Abboud 2003A, and Foley 2003).

Table I. Food products included and excluded by Title III of the Public Health Security and Bioterrorism Preparedness and Response Act of 2002

Included	Excluded
Dietary Supplements	Food contact substances
Infant Formula	Pesticides
Beverages (including alcoholic)	
Fruits and Vegetables	
Fish and Seafood	
Dairy Products & Shell Eggs	
Raw Agricultural Commodities	
Canned and Frozen Food	
Baking Goods & Snack Foods	
Live Animals for Food	
Animal Feeds and Pet Food	

Previous event studies in the supply chain and operations management literature have examined a variety of events: new supply chain management tools, supply chain disruptions, adoption of six sigma, ISO certification, changes in inventory turnover, food-borne disease outbreaks, and e-commerce initiatives. (See Table II for a summary.) Despite the large number of supply chain event studies, none examine the impact of regulation on the supply chain. In contrast, the finance, accounting, and economics literatures include many examples of regulatory event studies on a variety of topics: U.S. trade policy impacts on semi-conductor firms (Hughes et al., 1997); the impact of export taxes on Canadian softwood lumber (Joy et al 1998); the impact of product recalls (Jarrell and Peltzman, 1985); the effects of food recalls (Salin and Hooker, 2001); the effect of meat and poultry recalls (Thomsen and McKenzie 2001); deposit ceilings (Dann and James, 1982); merger regulations (Schipper and Thompson, 1983), environmental regulation and disclosure (Blacconiere and Patten, 1994) ; electric utility deregulation (Johnson et al 1998), and others.

Table II. Previous Event Studies on Supply-Chain and Operations Management Topics

Supply-Chain Management Tools	Joo-Hong 2008 Hendricks 2007 Ranganathan 2006 Filbeck 2005 Im 2001 Santo 1993
Supply-Chain Disruption	Hendricks 2005 Hendricks 2003
Adoption of Six Sigma	Shafer 2012
ISO Certification	Paulraj 2011
Changes in Inventory Turnover	Steinker 2013
Food-borne Disease Outbreaks	Sherwell 2006
E-commerce Initiatives	Dewan 2007 Subramani 2001

Our paper examines several aspects of the possible wealth effects of the Bioterrorism Act on the U.S food and beverage industry. These effects may occur due to cost and logistical problems that the Bioterrorism Act imposes on firms. The results also have implications for trade policy through a comparison of any impacts noted here for U.S. firms to effects previously noted for Canadian firms. From the hypotheses developed below, measures of the magnitude of economic losses to U.S. firms will be provided.

Taylor et al's results imply increased supply chain costs for both U.S. and Canadian firms, implying negative shareholder wealth effects from the passage of the Act. The effects may be caused by higher costs associated with record keeping and transportation of products or input across the border into the U.S., (including possible increases in spoilage and labor costs due to prior notice and possible administrative detention at the border). These costs are anticipated to be higher because they may increase documentation costs associated with tracking and keeping record of the supply chain they will have bear the increased costs associated with crossing the border with products into the U.S. Whether the cost is economically significant enough to cause significant negative ARs for U.S. firms is unknown without further study. On the other hand, McPherson claims that the BA is a non-tariff trade barrier. If the act is a non-tariff trade barrier then the impact of the informational events could be positive, as Canadian firms are disadvantaged relative to U.S. firms.

A major difficulty associated with testing the impact of the act is to choose the appropriate informational events. Specifically, at what times, and in what form, does the market receive information valuable to the process of forming expectations of future values for industry firms? In this study, we chose the most straightforward set of informational events we were able to find. The informational events and dates were obtained by examination of The Wall Street Journal, The Congressional Index, and The New York Times. We examine the introduction of the Bioterrorism Act in the House, its passage in the House and the Senate, and the signing of the Act by President Bush. We select the original introduction because this event provides the

market with a comprehensive indication of the likely regulatory impact of the Act. Subsequent passages in both houses of Congress are likely to revise market participants' expectations regarding the eventual passage of the Act. The fourth and final information event examined is the signing of the Act into law by President Bush. Since the law was highly complex, market participants are unlikely to know the costs implied by the final version until it is signed by the president. The chronology of the legislative actions that serve as our informational events appears in Table III.

Table III. Four Event Dates Associated with the Passage of the Public Health Security and Bioterrorism Preparedness and Response Act of 2002

<i>Date</i>	<i>Event</i>	Date	Legislative Action
12/11/2001	Event #1	12/11/2001	HR 3448 introduced in the House of Representatives
12/12/2001	Event #2	12/12/2001	HR 3448 passed by the House of Representatives
12/20/2001	Event #3	12/20/2001	Senate passes a version of the bioterrorism bill it will try to reconcile with a house bill passed back on December 12, 2002 NYT, HR 3448
6/12/2002	Event #4	6/12/2002	President George W. Bush signs into law; P.L. 107-188

Our earlier discussion suggests that the wealth effects of the Act could be positive or negative. Thus, our hypotheses are two-sided:

H1A: Introduction of the Act into the House changes the wealth of U.S. food industry shareholders.

H1B: Passage of the Act by the House changes the wealth of U.S. food industry shareholders.

H1C: Passage of the Act by the Senate changes the wealth of U.S. food industry shareholders.

H1D: Presidential signing of the Act changes the wealth of U.S. food industry shareholders.

Measures of the stock market reaction to legislative events may be confounded by firm-specific information releases during the event period such as mergers, earnings announcements, and dividend announcements. Therefore, we searched the *Wall Street Journal* and the *New York Times* for confounding events, as well as information leakage about our legislative events. This examination revealed that during the entire time that the bill was considered, there was ongoing discussion of the implications and possibility of passage of a Bioterrorism Act. However we were not able to discern specific events, which would be likely to alter investor expectations significantly.

The remaining hypotheses predict cross-sectional differences in the wealth effects of the Act explained by underlying economic differences in food industry firms' competitive situations. Two explanatory variables were used in this analysis, an indicator variable that captures whether the firm is a food processor and equity beta. We hypothesize that the Act imposes lower supply chain costs on processors, who have far fewer products (and, therefore, suppliers to track) than do, for example, grocery stores that sell thousands of consumer products. PROCES equals one if the firm's primary activity is food processing, zero otherwise.

As a measure of systematic market risk, a firm's beta can proxy for two attributes of a food industry firm's likely costs of complying with the Act. One, beta is a proxy for is the quality of the product being sold. Firms that produce superior goods tend to have higher betas. (For example, the demand for superior food products is more elastic than the demand for other food products implying higher risk.) Firms that produce higher quality products are likely to have better supply-chain control systems in place and are therefore likely to incur lower costs of complying with the Act's various provisions. Second, beta may proxy for is the degree to which the firm is diversified outside of the food industry. Firms in the food industry tend to have less market risk than the average firm in the market. Thus, high beta firms are likely to be more diversified outside of the food industry and, therefore, be less impacted by the Act. Each firm's equity beta, BETA, was obtained from the market model estimates used to calculate abnormal returns. Thus, our two final hypotheses are stated as:

H2A: Whether or not the firm is a processor will impact the size of returns experienced by the firm.

H2B: The firms Beta will impact the size of returns experienced by the firm.

III. Research Design

This section discusses the data and research design used in the study.

A list of all Food and Beverage firms publicly traded in the U.S. was assembled using Yahoo Finance and the CRSP database. Eighty-six firms had sufficient data for model estimation and testing. Table IV provides a list of these 86 firms along with their ticker symbol.

Table IV. Descriptive Data on 86 Sample Firms

#	Name	Ticker	SIC	Firm Activity
1	7 ELEVEN INC	SE	5411	Groceries, general line
2	ALBERTSONS INC	ABS	5411	Groceries, general line
3	AMCON DISTRIBUTING CO	DIT	5141	Groceries, general line
4	ANHEUSER BUSCH COS INC	BUD	2082	Malt beverages
5	ARCHER DANIELS MIDLAND CO	ADM	2041	Flour and grain mill products
6	AURORA FOODS INC	AOR	2051	Bread & other bakery products, except cookies and crackers
7	BOB EVANS FARMS INC	BOBE	5812	Eating places
8	BOSTON BEER INC	SAM	2082	Malt beverages
9	BRIDGFORD FOODS CORP	BRID	2013	Sausage & other prepared meat products
10	BROWN FORMAN CORP	BF	2084	Wines, brandy & brandy spirits
11	CAGLES INC	CGL	2011	Meat Packing Plants
12	CAL MAINE FOODS INC	CALM	2015	Poultry slaughtering & processing
13	CAMPBELL SOUP CO	CPB	2032	Canned specialties
14	CONAGRA INC	CAG	2041	Flour & grain mill products
15	CONSTELLATION BRANDS INC	STZ	2084	Wines, brandy & brandy spirits
16	CORN PRODUCTS INTERNATIONAL INC	CPO	2046	Wet corn milling
17	DEAN FOODS CO	DF	2024	Ice cream & frozen desserts
18	DEL MONTE FOODS CO	DLM	2033	Canned fruits, vegetables, preserves and jellies
19	DOLE FOOD INC	DOL	2033	Canned fruits, vegetables, preserves and jellies
20	DREYERS GRAND ICE CREAM	DRYR	2024	Ice cream & frozen desserts

	INC			
21	FARMER BROTHERS FOODS INC	FARM	2095	Roasted coffee
22	FLEMING COMPANIES INC	FLM	5141	Groceries, general line
23	FLOWERS INDUSTRIES INC	FLO	2051	Bread & other bakery products, except cookies and crackers
24	FOODARAMA SUPERMARKETS INC	FSM	5411	Grocery Stores
25	FORTUNE BRANDS INC	FO	2085	Distilled & blended liquors
26	FRESH BRANDS INC	FRSH	5141	Groceries, general line
27	FRESH DEL MONTE PRODUCE INC	FDP	5149	Groceries and related products, not classified elsewhere
28	GALAXY NUTRITIONAL FOODS INC	GXY	2022	Natural Process and imitation cheese
29	GENERAL MILLS INC	GIS	2043	Cereal breakfast foods
30	GENESEE CORP	GENBB	2082	Malt beverages
31	GOLDEN ENTERPRISES INC	GLDC	2051	Bread & other bakery products, except cookies and crackers
32	GREAT ATLANTIC & PAC TEA INC	GAP	5411	Grocery Stores
33	GREEN MOUNTAIN COFFEE INC	GMCR	2095	Roasted coffee
34	GRISTEDES FOODS INC	GRI	5411	Grocery Stores
35	HAIN CELESTIAL GROUP INC	HAIN	2099	Food preparation, not elsewhere classified
36	HEINZ H J CO	HNZ	2032	Canned specialties
37	HERSHEY CO	HSY	2066	Chocolate & Cocoa products
38	HORMEL FOODS CORP	HRL	2011	Meat Packing Plants
39	INTERNATIONAL MULTIFOODS CORP	IMC	2041	Flour & grain mill products
40	INTERSTATE BAKERIES CORP DE NEW	IBC	2051	Bread & other bakery products, except cookies and crackers
41	KELLOGG CO	K	2041	Flour & grain mill products
42	KRAFT FOODS INC	KFT	2099	Food preparation, not elsewhere classified
43	KROGER COMPANY	KR	5411	Groceries, general line
44	LANCASTER COLONY CORP	LANC	2035	Pickled fruits, vegetables, vegetable sauces & seasonings
45	LANCE INC	LNCE	2052	Cookies & crackers
46	LIFEWAY FOODS INC	LWAY	2026	Fluid milk
47	MARSH SUPERMARKETS INC	MARS A	5411	Grocery Stores
48	MAUI LAND & PINEAPPLE CO INC	MLP	2033	Canned fruits, vegetables, preserves and jellies
49	MIDWEST GRAIN PRODUCTS	MGP	2085	Distilled & blended liquors
50	MORGANS FOODS INC	MR	2033	Canned fruits, vegetables, preserves and jellies
51	NASH FINCH COMPANY	NAFC	5411	Grocery Stores
52	NATIONAL BEVERAGE CORP	POPS	2086	Bottled and canned soft drinks
53	PATHMARK STORES INC	PTMK	5411	Grocery Stores
54	PEETS COFFEE AND TEA INC	PEET	2095	Roasted coffee
55	PEPSICO INC	PEP	2086	Bottled and canned soft drinks
56	PILGRIMS PRIDE CORP	CHX	2015	Poultry slaughtering & processing
57	POORE BROTHERS INC	POOR	2051	Bread & other bakery products, except cookies and crackers
58	PROVENA FOODS INC	PZA	2013	Sausage & other prepared meat products
59	RICA FOODS INC	RCF	2015	Poultry slaughtering & processing
60	ROCKY MOUNTAIN CHOCOLATE FACTORY	RMCF	2064	Candy and other confectionary products

61	RUDDICK CORP	HTSI	2281	Eating places
62	SAFEWAY INC	SWY	5411	Grocery Stores
63	SANDERSON FARMS INC	SAFM	2015	Poultry slaughtering & processing
64	SANFILIPPO JOHN B AND SON	JBSS	5141	Groceries, general line
65	SARA LEE CORP	SLE	2013	Sausage & other prepared meat products
66	SEABOARD CORP	SEB	2041	Flour & grain mill products
67	SENECA FOODS CORP NEW	SENEA	2033	Canned fruits, vegetables, preserves and jellies
68	SENSIENT TECHNOLOGIES CORP	SXT	2037	Frozen fruits, juices & vegetables
69	SHERWOOD BRANDS INC	SHD	2061	Cane sugar, except refining
70	SMITHFIELD FOODS INC	SFD	2013	Sausage & other prepared meat products
71	SMUCKER J M CO	SJM	2033	Canned fruits, vegetables, preserves and jellies
72	SUPERVALU INC	SVU	5141	Groceries, general line
73	SYNERGY BRANDS INC	SYBR	5141	Groceries, general line
74	SYSCO CORP	SYU	5142	Packaged frozen foods
75	TASTY BAKING CO	TSTY	2051	Bread & other bakery products, except cookies and crackers
76	TODHUNTER INTERNATIONAL	THT	2084	Wines, brandy & brandy spirits
77	TOFUTTI BRANDS INC	TOF	2024	Ice cream & frozen desserts
78	TOOTSIE ROLL IND INC	TR	2064	Candy and other confectionary products
79	TYSON FOODS INC	TYSN	2015	Poultry slaughtering & processing
80	UNI MARTS INC	UNI	5411	Grocery Stores
81	VILLAGE SUPER MARKET INC	VLGEA	5411	Grocery Stores
82	WEIS MARKETS INC	WMK	5411	Grocery Stores
83	WHOLE FOODS MARKET INC	WFM	5411	Grocery Stores
84	WILAMETTE VALLEY VINYDS INC	WVVI	2084	Wines, brandy & brandy spirits
85	WINN DIXIE STORES INC	WIN	5411	Grocery Stores
86	WRIGLEY WILLIAM JR CO	WWY	2067	Chewing gum

The hypothesis is tested by examining the overall industry market reaction to the four informational events. These potential informational events, discussed in Section 2.3 and listed in Table III, are the events associated with the introduction to the House, the passage by the House, and the passage of a parallel bill by the Senate, and the signing into law of Bioterrorism Act. For each of the informational event dates, the market reaction was determined by measuring daily abnormal returns, which are the difference between actual and expected returns. To control for the effects of market-wide fluctuations, the market model is used to measure expected returns:

$$R_{it} = \alpha_i + \beta_i R_{mt} + e_{it}$$

Where: R_{it} is the return for the i th agribusiness firm on day t ,
 α_i is the intercept for the i th agribusiness firm,
 β_i is the slope coefficient for the i th agribusiness firm,
 R_{mt} is the return on an equal-weighted market portfolio on day t , and
 e_{it} is the error term with mean zero

Following the convention of previous event studies (e.g. Hughes et al. 1986; Jarrell and Peltzman 1985; Johnson et al. 1998, Brown and Warner 1980, 1985, and Binder and Summer 1985), an equal-weighted market index is used as a proxy for the market rate of return. The

parameters α_i and β_i were estimated using 255 trading days of daily return data. Generally speaking, in event studies, we want the parameters of the model to be estimated over a short time period before the event occurs. This involves a tradeoff. The closer the estimation period is to the event period, the less likely it is that sample firm betas have changed due to changes in leverage, management strategy, and firm investments, etc. But, estimation data from a period too close to the event period may be contaminated by abnormal returns that were caused during previous regulatory announcements or proceedings. We choose to estimate the parameters of the model using 255 days of data 46 days prior to the first event. Once the parameters α_i and β_i have been estimated for each firm, the daily prediction errors (i.e., abnormal returns) for firm i were calculated as follows:

$$AR_{it} = R_{it} - [\alpha_i + \beta_i R_{mt}]$$

Where: AR_{it} is the abnormal return for firm i on day t .

We examine abnormal returns for the three-day window that includes the event day and the trading day immediately before and after the event. Inclusion of the trading day prior to the event controls for information leakage that may occur if some market participants are privy to discussions among policy makers prior to public announcement of policy actions. Inclusion of the trading day after the event accounts for late arrival of information to the market or adjustment to information that requires time for market participants to interpret. A window that is too large will include extraneous information. Conversely, a window that is too small will not fully capture the effects of information leakage or slow market adjustment. We choose a short window of 3-days. Thus, our results are conservative and may underestimate the impact of the Bioterrorism Act. The three day cumulative abnormal returns for each firm were computed as below:

$$CAR_i = \sum_{t=-1}^{+1} AR_{it}$$

Where: CAR_i is the cumulative abnormal return for firm i ,
 AR_{it} is the abnormal return for firm i on day t , and
 $t=0$ is the day of the event occurred.

To determine the average overall impact of the event on the industry, we calculate the three-day cumulative average abnormal return by summing across the n firms in the sample and dividing by n as below:

$$CAAR = \sum_{i=1}^{86} CAR_i / 86$$

Where: $CAAR$ is the cumulative average abnormal return for the sample, and
 CAR_i is the 3-day cumulative return for firm i around the event.

To examine whether each informational event had a significant average return effect on the

industry, a test of the null hypothesis that the three-day cumulative average abnormal return across firms equals zero is performed using a generalized Z-statistic and a Crude Dependence Adjustment (CDA) test.

To examine how the wealth effects of the Bioterrorism Act vary across firms, we estimate the following model:

$$CAR_i = \gamma_0 + \gamma_1 PROCES + \gamma_2 BETA$$

where CAR_i is defined above, $PROCES$ is an indicator variable that equals one if the firm is a processing firm, else zero and $BETA$ is the slope coefficient from the market model used to estimate abnormal returns. The hypotheses imply a two-sided prediction for the coefficient, γ_1 , and a positive coefficient, γ_2 . The cross-sectional regression results are discussed in Section IV.

IV. Results

This section discusses the results of the statistical analysis.

Table V. Three-Day Cumulative Average Abnormal Returns (CAARs) for 86 U.S. Agribusiness Firms Around Four Event Dates Associated with the Passage of the Public Health Security and Bioterrorism Preparedness and Response Act of 2002

<i>Legislative Action</i>	<i>Cumulative Average Abnormal Returns</i>	<i>Generalized Z-statistic (p-value)</i>	<i>Crude Dependence Adjustment Test (p-value)</i>	<i># Positive/# Negative</i>
Event #1	-1.53%	-2.182 (.0146)	-1.513 (.0652)	31/55
Event #2	-1.21%	-.887 (.1876)	-1.192 (.1166)	37/49
Event #3	0.84%	1.722 (.0425)	.820 (.2061)	49/37
Event #4	-1.58%	-3.652 (.0001)	-1.732 (.0417)	23/63

Table V presents the cumulative average abnormal return results for the four legislative events. The mean cumulative abnormal return for Event 1, the introduction of the Bioterrorism Act, is -1.5%, which is statistically significant at the 0.065 level for the Crude Dependency Adjusted (CDA) test. The CDA is a more appropriate test statistic for a regulatory event study than is the generalized Z-statistic because the CDA controls for interdependency of returns that occurs when the event dates are the same for each sample firm. (See Brown and Warner 1980, 1985 for additional explanation.) However, the generalized Z-statistic is also provided, and inferences from the two test statistics are qualitatively similar. Events 2 and 3, passage by the House and the Senate, were found to have insignificant effects on the firms in the sample. However, Event 4, the signing by the president, produced a -1.58% return that is significant at the 0.4% level. The sum of the abnormal returns over events 1 and 4 events implies a 3.2% decrease in the market value of the average food industry firm in response to the enactment of

the Bioterrorism Act.

Table VI. Three-Day Cumulative Abnormal Returns (CARs) for 86 U.S. Agribusiness Firms Around Four Event Dates Associated with the Passage of the Public Health Security and Bioterrorism Preparedness and Response Act of 2002

<i>Firm Name</i>	<i>Event #1</i>	<i>Event #2</i>	<i>Event #3</i>	<i>Event #4</i>
7 ELEVEN INC	-0.0840	-0.0498	-0.0592	-0.0014
ALBERTSONS INC	-0.0992	-0.0907	0.0163	-0.1042
AMCON DISTRIBUTING CO	0.0106	-0.0290	0.1393	-0.0189
ANHEUSER BUSCH COS INC	0.0080	0.0044	0.0688	0.0191
ARCHER DANIELS MIDLAND CO	-0.0531	-0.0413	-0.0349	-0.0389
AURORA FOODS INC	-0.0014	0.0156	-0.0040	0.0714
BOB EVANS FARMS INC	0.0025	-0.0121	-0.0138	-0.0188
BOSTON BEER INC A	-0.0249	-0.1663	0.0825	0.0259
BRIDGFORD FOODS CORP	-0.0302	0.0193	-0.0308	0.0051
BROWN FORMAN CORP A	-0.0134	-0.0046	0.0544	-0.0176
CAGLES INC A	0.0139	-0.0966	0.0479	-0.0169
CAL MAINE FOODS INC	-0.0196	-0.0318	-0.0267	-0.0178
CAMPBELL SOUP CO	-0.0028	0.0078	0.0200	-0.0076
CONAGRA INC	-0.0182	0.0046	0.0017	-0.0168
CONSTELLATION BRANDS INC A	0.0132	0.0128	0.0656	-0.0426
CORN PRODUCTS INTERNATIONAL INC	-0.0107	0.0142	0.0263	-0.0239
DEAN FOODS CO	-0.0188	-0.0171	0.0248	0.1136
DEL MONTE FOODS CO	0.0089	0.0174	-0.0046	-0.0015
DOLE FOOD INC	-0.0048	0.0196	-0.0363	-0.0165
DREYERS GRAND ICE CREAM INC	0.0205	0.0496	-0.0260	0.0021
FARMER BROTHERS CO	0.0155	-0.0287	0.0215	-0.0454
FLEMING COMPANIES INC	-0.0855	-0.0691	-0.0239	-0.0339
FLOWERS FOODS INC	-0.0370	-0.0110	-0.0065	-0.0076
FOODARAMA SUPERMARKETS INC	-0.0036	0.0043	-0.0246	0.0163
FORTUNE BRANDS INC	-0.0084	-0.0029	0.0026	-0.0004
FRESH BRANDS INC	0.0263	0.0176	0.0923	0.0767
FRESH DEL MONTE PRODUCE INC	-0.0079	-0.0003	-0.0481	-0.0042
GALAXY NUTRITIONAL FOODS INC	-0.0219	-0.0401	0.0178	-0.0188
GENERAL MILLS INC	-0.0186	0.0034	0.0275	0.0254
GENESEE CORP B	0.1035	0.1088	-0.0025	0.0898
GOLDEN ENTERPRISES INC	0.0092	0.0224	-0.0308	-0.1142
GREAT ATLANTIC & PAC TEA INC	-0.2099	-0.1151	0.0380	-0.0812
GREEN MOUNTAIN COFFEE INC	0.0336	0.0216	0.0007	0.0134
GRISTEDES FOODS INC	-0.0777	-0.0240	0.0166	-0.0105
HAIN CELESTIAL GROUP INC	0.0055	0.0412	0.0074	-0.0301
HEINZ H J CO	-0.0148	0.0210	0.0086	-0.0294
HERSHEY FOODS CORP	-0.0081	-0.0022	0.0236	-0.0386
HORMEL FOODS CORP	0.0136	-0.0060	0.0023	-0.0160

INTERNATIONAL MULTIFOODS CORP	0.0074	0.0097	-0.0058	-0.0150
INTERSTATE BAKERIES CORP DE NEW	-0.0938	-0.0862	0.0281	0.0494
KELLOGG CO	-0.0147	0.0102	0.0071	-0.1044
KRAFT FOODS INC A	0.0046	0.0106	0.0344	-0.0096
KROGER COMPANY	-0.1987	-0.1440	0.0179	-0.0252
LANCASTER COLONY CORP	0.0142	-0.0233	-0.0293	0.2027
LANCE INC	-0.0275	-0.0590	-0.0417	-0.0194
LIFEWAY FOODS INC	0.0788	0.0158	-0.0056	0.0612
MARSH SUPERMARKETS INC A	0.0156	0.0004	0.0394	0.0849
MAUI LAND & PINEAPPLE CO INC	0.0136	0.0128	0.0031	-0.0031
MIDWEST GRAIN PRODUCTS INC	-0.0006	-0.0232	-0.0088	-0.0157
MORGANS FOODS INC	0.1671	0.0531	0.4982	-0.0184
NASH FINCH COMPANY	-0.0187	-0.0048	0.0089	-0.0337
NATIONAL BEVERAGE CORP	-0.0036	0.0098	0.0041	-0.0410
PATHMARK STORES INC	-0.0725	-0.0661	0.0142	-0.0057
PEETS COFFEE AND TEA INC	0.0074	-0.0426	0.0323	-0.0268
PEPSICO INC	-0.0127	0.0035	0.0355	-0.0097
PILGRIMS PRIDE CORP A	-0.0517	-0.0533	-0.0142	-0.0902
POORE BROTHERS INC	0.0303	0.0543	-0.0221	0.0836
PROVENA FOODS INC	0.1605	0.0934	-0.0977	-0.0822
RICA FOODS INC	-0.0492	-0.0863	-0.2209	-0.0359
ROCKY MOUNTAIN CHOCOLATE FAC IN	-0.0658	-0.0626	-0.0255	-0.1959
RUDDICK CORP	-0.0203	-0.0203	0.0108	0.0009
SARA LEE CORP	-0.1272	-0.0101	0.0169	-0.0294
TODHUNTER INTERNATIONAL INC DE	-0.0540	0.0122	0.0556	0.0067
SAFEWAY INC	-0.0853	-0.0854	-0.1601	-0.0236
SANDERSON FARMS INC	-0.0158	-0.0291	0.0113	-0.0352
SANFILIPPO JOHN B & SON	0.0352	-0.0136	0.0020	-0.2003
SEABOARD CORP	0.0211	0.0245	-0.0057	0.0167
SENECA FOODS CORP NEW A	-0.0319	0.0201	0.0232	-0.0039
SENSIENT TECHNOLOGIES CORP	0.0207	-0.0126	-0.0278	-0.0537
SHERWOOD BRANDS INC A	-0.0393	0.1162	-0.0135	-0.0405
SMITHFIELD FOODS INC	-0.0202	-0.0400	-0.0066	0.0280
SMUCKER J M CO	-0.1231	-0.0211	0.0378	-0.1024
SUPERVALU INC	0.0690	-0.1178	-0.0362	0.0258
SYNERGY BRANDS INC	-0.0244	0.0865	0.0793	-0.0461
SYSCO CORP	-0.0063	-0.0073	-0.0183	-0.1099
TASTY BAKING CO	0.0210	-0.0070	0.0133	-0.0232
TOFUTTI BRANDS INC	0.0206	-0.0024	-0.0279	-0.0157
TOOTSIE ROLL INDS INC	-0.0048	0.0004	-0.0033	0.0654
TYSON FOODS INC A	-0.0302	-0.0090	-0.0456	-0.0680
UNI MARTS INC	-0.0062	0.0340	0.0191	0.0286

VILLAGE SUPER MARKET INC A	0.0068	0.0169	-0.0252	-0.0071
WEIS MARKETS INC	-0.0195	-0.0192	0.0044	-0.0241
WHOLE FOODS MARKET INC	-0.0971	-0.0691	0.0194	-0.0145
WILLAMETTE VALLEY VINYS INC	-0.0042	-0.0032	0.0882	-0.0297
WINN DIXIE STORES INC	-0.0808	-0.0605	0.0184	-0.0396
WRIGLEY WILLIAM JR CO	-0.0168	-0.0076	0.0317	-0.1026

Summary Data:

Minimum	-0.2099	-0.1663	-0.2209	-0.2003
Maximum	0.1671	0.1162	0.4982	0.2027
Median	-0.0107	-0.0060	0.0031	-0.0176
25 th Percentile	-0.0370	-0.0401	-0.0239	-0.0389
75 th Percentile	0.0106	0.0142	0.0248	0.0021

Table VI presents the individual firm cumulative abnormal returns (CARs) for the 3-day event windows associated with the four events. For the first of the two significant events, Event 1, the 25th percentile CAR, -3.70%, is more than three times larger in absolute magnitude than the 75th percentile CAR, 1.06%. For the second of the two significant events, Event 4, the 25th percentile CAR, -3.89%, is more than 15 times larger in absolute magnitude than the 75th percentile CAR, 0.21%. Therefore, we conclude that the significance of the average CARs cannot be explained by a small number of outliers. However, an examination of the individual CARs shows that there is considerable heterogeneity. Hence, we also explore the factors that explain variation across firms in the magnitude of the CARs.

Table VII. Cross Sectional Regression Analysis and Correlation of Variables in the Panel A: Regression Results

	<i>Coefficient</i>	<i>Standard Error</i>	<i>t-stat</i>	<i>p-value</i>
Intercept	-0.1004	0.0229	-4.4138	0.0001
PROCES	0.0737	0.0223	3.3110	0.0014
BETA	0.0488	0.0284	1.7204	0.0891
R2	0.1254			
Adj. R2	0.1043			
Std Error	0.0911			
N	86			

Panel B: Pearson Correlations

	<i>CAAR</i>	<i>PROCES</i>	<i>BETA</i>
<i>CAAR</i>	1		
<i>PROCES</i>	0.3069	1	
<i>BETA</i>	0.0993	-0.2355	1

Table VII presents the results of the cross sectional analysis. The results are consistent with the hypotheses presented in Section II of the paper. A simple two factor regression explains 10.9% of the variation in CARs across firms. The p-values associated with the slope coefficients are .0014 and .089 for PROCESS and BETA, respectively. Thus, processing firms and firms with high betas lost less wealth from the passage of the Bioterrorism Act than non-processing firms. One interpretation is that these firms have a less diverse supply chain, so incur lower costs associated with the record keeping requirements of the Bioterrorism Act.

V. Supporting Evidence from Earlier Legislation: The Wealth Effects of the Sanitary and Food Transportation Act

This section examines an addition food industry law in order to provide evidence that federal legislation regulating the food industry, in general, has a negative impact on U.S. food firms. The Sanitary Food Transportation Act of 1990 (the 1990 Act) was proposed and passed by the federal government. This legislation was an attempt to more closely monitor and regulate the food supply chain in the U.S. by regulating food transportation and shipping. The 1990 Act requires the Secretary of Transportation to issue regulations governing the transport of food in motor or rail vehicles that are also used to transport refuse or other nonfood products that may pose a health hazard to animals or consumers. The chronological process leading to the passage of the 1990 Act was very similar to that for the Bioterrorism Act: Introduction to the House, passage by the House, passage by the Senate, and signing by the President. We use the same methodology to examine these four events was identical as was used in sections 2 and 3 to examine the wealth effects of the Bioterrorism Act. That is, we estimated market model parameters using 255 days of trading data ending on the 46th day before the first event. Table 8 provides a summary of the results. Using the CDA statistic and a p-value cutoff of 10%, we conclude that the first three events are insignificant. Event # 4, the signing of the 1990 Act, produced a -1.15% effect on the industry. While this effect is smaller than that found for the Bioterrorism Act, this result nonetheless supports the idea that food regulation that is similar in spirit to the Bio-terrorism Act, overall, has negative consequences for the industry.

Table VIII. Three-Day Cumulative Average Abnormal Returns (CAARs) for 57 U.S. Agribusiness Firms Around Four Event Dates Associated with the Passage of the Sanitary and Food Transportation Act

<i>Legislative Action</i>	<i>Cumulative Average Abnormal Returns</i>	<i>Generalized Z-statistic (p-value)</i>	<i>Crude Dependence Adjustment Test (p-value)</i>	<i># Positive/#Negative</i>
<u>Event #1:</u> Introduced in the House 10/02/1989	-0.33%	-1.767 (.0386)	-0.503 (.3073)	19/38
<u>Event #2:</u> Passed by the	0.36%	1.136	0.564	30/27

House 1/27/1990		(.1280)	(.2864)	
<u>Event #3:</u> Passage by the Senate 9/20/1990	0.79%	3.542 (.0002)	1.264 (.1030)	39/18
<u>Event #4:</u> Signed by the President 11/03/1990	-1.15%	-2.048 (.0203)	-1.839 (.0330)	18/39

VI. Summary and Conclusions

On June 12, 2002, President Bush signed into law the Public Health Security and Bioterrorism Preparedness and Response Act of 2002. The Bioterrorism Act altered the regulatory climate for any food industry firm with a presence in the U.S. Our study indicates that shareholders of U.S. food industry firms experienced significant declines in wealth in response to various events leading to the passage of the Bioterrorism Act.

The negative shareholder wealth effects are likely attributable to increased costs arising from the Act's requirements that agribusiness firms register their facilities with the U.S. government, provide notice prior to the shipment of food items, and keep record of the origination of food inputs and the destination of food outputs. Consistent with this argument, we find evidence of stronger negative wealth effects for firms with greater product diversity (and, hence, higher reporting costs), as proxied by the non-food processing sector of the industry and beta. Our results imply that the average magnitude of these costs may be as large as 3% of equity value.

Prior research that examines the impact of the Bioterrorism Act on Canadian food industry firms with a presence in the U.S. concludes that the Bioterrorism Act is a non-tariff barrier to trade (MacPherson, 2008). In contrast, we conclude that the Act does not constitute a non-tariff barrier to Canadian food industry firms because the negative wealth effects on U.S. firms are of a comparable magnitude to those reported for Canadian firms by Johnson et al. (2013).

References

- Abboud, Leila, 2003A, “New rules aim at protecting the U.S. food supply,” *Wall Street Journal* (Eastern edition), New York, N.Y.: Jan 30, pp. D.5.
- Abboud, Leila, 2003B, “Antiterrorism's hidden costs --- food industry fights FDA's extensive new rules for imports,” *Wall Street Journal* (Eastern edition), New York, N.Y.: Mar 26, 2003, pp. A.4.
- Binder, J. and Summer, J., 1985. “Measuring the effects of regulation with stock price data,” *Rand Journal of Economics* Vol. 16, Issue 2, pp. 167–183.
- Blacconiere, W.G. and Patten, D.M., 1994, “Environmental disclosures, regulatory costs, and changes in firm value,” *Journal of Accounting and Economics* Vol. 18, Issue 3, pp. 357–377.
- Boisen, Claire S, 2007, “Title III of the bioterrorism act: sacrificing U.S. trade relations in the name of food security.” *American University Law Review* Washington: Feb 2007, Vol. 56, Issue 3, pp. 667.
- Brown, S.J. and Warner, J.B., 1980, “Measuring security price performance,” *Journal of Financial Economics* Vol. 8, Issue 3, pp. 205–258.
- Brown, S.J. and Warner, J.B., 1985, “Using daily stock returns: The case of event studies,” *Journal of Financial Economics* Vol. 14, Issue 1, pp. 3–31.
- Coffee Distributing Corporation, Home page, <http://www.cdccoffee.com/green-mountain-coffee-roasters-history.html> (last accessed November 14, 2014).
- Dann, L.Y. and James, C.M., 1982, “An analysis of the impact of deposit rate ceilings on the market values of the thrift institutions,” *The Journal of Finance* Vol. 37, Issue 5, pp. 1259–1275.
- Filbeck, Greg, Raymond Gorman, Timothy Greenlee, and Thomas Seph, 2005, “The Stock Price Reaction to Supply Chain Management Advertisements and Company,” *Journal of Business Logistics*, Vol. 26, Issue 1, pp. 199-216.
- Foley, Ryan J., and Mathews, A.W., 2003, “Regulators unveil rules to protect U.S. food supply.” *Wall Street Journal* (Eastern edition), New York, N.Y.: Oct 10, pp. B.5.
- Food and Drug Administration, 2012, <http://www.fda.gov/RegulatoryInformation/Legislation/ucm155769.htm> (last accessed April 7, 2012).
- Fox, Jeffrey L., 2005, “U.S. biosecurity advisory board faces delicate balancing act,” *Nature Biotechnology* August, Vol. 23, Issue 8, pp. 905.
- Hendricks, Kevin B. and Vinod R. Singhal, 2005, “An empirical analysis of the effect of supply chain disruptions on long-run stock price performance and equity risk of the firm,” *Production and Operations Management* Vol. 14, Issue 1, pp. 35-52.
- Hendricks, Kevin B. and Vinod R. Singhal, 2003, “The effect of supply chain glitches on shareholder wealth”, *Journal of Operations Management* Vol. 21, Issue 5, pp. 501-522.
- Hendricks, Kevin B., Vinod R. Singhal Jeff K. Stratman, 2007, “The impact of enterprise systems on corporate performance: A study of ERP, SCM and CRM system implementations,” *Journal of Operations Management* Vol. 25, Issue 1, pp. 65.
- Hughes, John S., Stefanie Lenway, and Judy Rayburn, 1997, “Stock price effects of U.S. trade policy responses to Japanese trading practices in semi-conductors,” *Canadian Journal of Economics* Vol. 30, Issue 4, pp. 922-42.
- Im, Kun Shin, Kevin E. Dow, and Varun Grover, 2001, “Research report: A re-examination of IT investment and the market value of the firm – An event study methodology,” *Information Systems Research* Vol. 12, Issue 1, pp. 103-117.
- India-West, Anonymous, 2010, “AAHOA lauds bioterrorism act,” March 26, 2010, p. B.7.

- Jarrell, G. and Peltzman, S., 1985, "The impact of product recalls on the wealth of sellers," *Journal of Political Economics* Vol. 93, Issue 3, pp. 512–536.
- Johnson, M.S., Niles, M., and Suydam, S., 1998, "Regulatory changes in the electric utility industry: investigation of effects on shareholder wealth." *Journal of Accounting and Public Policy* Vol. 17, Issue 4-5, pp. 285-309.
- Johnson, M.S., Zhao, C., and Garg, M., 2013, "The impact of the bio-terrorism act on the wealth of Canadian food and beverage firms," *International Research Journal of Applied Finance* Vol. 4, Issue 3, pp. 1182-1193.
- Kroger Company, Home page, <http://www.thekrogerco.com/> (last accessed November 14, 2014).
- MacPherson, Alan., 2008, "The Impact of the U.S. bio-terrorism act upon Canadian exporters of food products to the United States: A firm level analysis," *The International Trade Journal* Vol. 22, Issue 1, pp. 17-38.
- Murphy, Sean D., 2004, "Bioterrorism act's notice requirements for food imports," *The American Journal of International Law* Vol. 98, Issue 4, pp. 837-839.
- New York Times*, multiple issues.
- Ontario Chamber of Commerce, 2005, "Cost of border delays to the United States economy," report prepared by the Ontario Chamber of Commerce Borders and Trade Development Committee. <http://www.occ.on.ca/2004/CostofBorderDelayto-ontario-report/> (last accessed April 7, 2012).
- O'Rourke, Morgan., 2003, "FDA proposes bioterrorism rules to protect U.S. food security," *Risk Management* Vol. 50, Issue 4, pp. 12-12.
- Paulraj, Anthony and Pieter de Jong, 2011, "The effect of ISO 14001 certification Announcements on stock performance," *International Journal of Operations and Production Management* Vol. 31, Issue 7, pp. 756-788.
- Ranganathan, C. and Carol V. Brown, 2006, "ERP investments and the market value of firms: Toward an understanding of influential ERP project variables," *Information Systems Research* Vol. 17, Issue 2, pp. 145-161.
- Salin, V. and Hooker, N.H., 2001, "Stock market reaction to food recalls," *Review of Agricultural Economics* Vol. 23, Issue 1, Issue, pp 33-46.
- Santos, Dos, Ken Peffers, and David C. Mauer, 1993, "The impact of information technology investment on the market value of the firm," *Information Systems Research*. Vol. 4, Issue 1.
- Schipper, K. and Thompson, R., 1983, "The impact of merger-related regulations on the shareholders of the acquiring firms," *Journal of Accounting Research* Vol. 21, Issue 1, pp. 184–221.
- Shafer, Scott M. and Sara B. Moeller, 2012, "The eEffects of six sigma on corporate performance: An empirical investigation," *Journal of Operations Management* Vol. 30, Issue 7-8, pp. 521-532.
- Steinker, Sebastian and Kai Hoberg, 2013, "The impact of inventory dynamics on long-term stock returns – An empirical investigation of U.S. manufacturing companies," *Journal of Operations Management* Vol. 31, Issue 5, pp. 250.
- Taylor, J.C., Robideaux, D.R. and Jackson, G.C., 2004, "U.S-Canada transportation and logistics: Border impacts and costs, causes, and possible solutions," *Transportation Journal* Vol. 43, Issue 4, pp. 5-21.
- Thomsen, Michael R., and Andrew M. McKenzie., 2001, "Market incentives for safe foods: An examination of shareholder losses from meat and poultry recalls," *American Journal of Agricultural Economics* Vol.83, Issue 3, (2001): 526-38.

Vincent, Michel, 2007, "Extending protection at the WTO to products other than wines and spirits: Who will benefit," *The Estey Centre Journal of International Law and Trade Policy* Vol. 8, Issue 1, 57-68.

Wall Street Journal, multiple issues.

Risk Perceptions of Mutual Funds-Evidence from an Experimental Approach

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Abstract

Analysis of mutual fund advertisements in previous research has shown that most (88%) do not contain all the requisite information on the risk-return trade-off, principal-agent conflict, and transaction costs that consumers need to optimize their investment decisions. This research reports the findings of an experiment carried out to understand the Huhmann-Bhattacharyya (2005) paradox. Results indicate that including information on risk-return trade-off, principal-agent conflict, and transaction costs in mutual fund advertisements increase consumer risk perceptions of the mutual fund. This result has important policy implication for levelling the playing field in mutual fund advertising. For example an interesting and important public policy question would be whether or not financial literacy training alters advertising information usage and attitudes. Results could help determine public policy on imparting financial literacy training to the general population.

I. Introduction

Financial markets and institutions channel funds from the savings sectors of the economy to the investing sectors of the economy. An efficient financial market is indispensable for the efficient allocation of resources into productive ventures. Mutual funds are important players in the financial markets.

Mutual funds depend on funds flow from investors and try to attract the attention of these investors through various means. Advertisements constitute one such channel. It is well established that mutual fund families that spend more on advertising attract more funds from investors (e.g., Barber, Odean, and Zheng 2005; Korkeamaki, Puttonen, and Smythe, 2007; Sirri and Tufano, 1998; Yankow, Smythe, Lesseig and Jones, 2011). Further, Jain and Wu (2000) found that the 294 mutual funds that advertised in *Barron's* or *Money* magazine grew faster than a control group of funds with similar prior performance.

One would expect that mutual fund advertisements would carry the information relevant to investors for their decision-making. Theories of finance hold that the information required for investment decision making can be classified under three categories: information on the risk-return trade-off (e.g. Jordan and Kaas, 2002; Huang and Litzenberger, 1988 and Ingersol, 1987), information on transaction costs (e.g. (Chordia, 1996; Dellva and Olson, 1998; Livingston and O'Neal, 1996 & 1998 and Ramasamy and Yeung, 2003), and information to mitigate agency costs (e.g. Arya, Glover and Rajan, 2000; Ross, 1973; Holmstrom, 1979; Fama, 1980; Grossman and Hart, 1983 and Ramasamy and Yeung, 2003).

Huhmann and Bhattacharyya (2005) conducted a content analysis of mutual fund advertisements to see whether these advertisements indeed carry the type of information deemed relevant by finance theory. They found that most (88.8 per cent) mutual fund advertisements did

not contain all the requisite information on the risk-return trade-off, principal-agent conflict, or transaction costs that consumers needed to optimize investment decisions. The objective of the current paper is to resolve the puzzle as to why mutual fund advertisements would not carry the requisite financial information expected based on the finance literature. It finds that if mutual fund advertisements do contain relevant information, then the advertised mutual fund is perceived to be risky. This would explain Huhmann and Bhattacharyya's (2005) earlier finding that mutual fund advertisements, by and large, do not contain all relevant financial information.

II. Literature Review

Prior research has found that risk, investment style, past performance, expenses, manager tenure, and fund age explain a significant amount of the variation in subsequent mutual fund returns (Peterson, Pietranico, Riepe, and Xu, 2001). Studies of the information that financial advisors use in evaluating mutual funds finds that previous performance, transaction costs, fund size, and fund manager experience and qualifications are particularly important (Ramasamy and Yeung, 2003). Prior research has also documented a negative relation between fund flows and total fund expenses, such as amortized front-end-load fees and operating expenses (Sirri and Tufano, 1998). There is a trade-off between risk and return; therefore, higher returns are often required to compensate for greater risk (Tasari, Bolton, Hutt, and Walker, 2011). So, from a financial point of view, consumers require risk-return, transaction cost, and agency information to optimize investment decisions.

Advertising is a primary information source for consumer's mutual fund investment decisions. A recent survey found that 40% of all consumers used Internet or periodicals when planning mutual fund investments (Pellinen, Törmäkangas, Uusitalo, and Raijas, 2011). Therefore, consumers should value informative mutual fund advertising because it reduces their search costs (Sirri and Tufano, 1998).

More informative advertising for a service concretizes the advertised product in consumers' minds, which reduced purchase risk (Abernethy, Gray, and Butler, 1997). Perceived risk can be further reduced when service advertising includes quality cues emphasizing reliability, assurance, responsibility and tangibility (Clow, Baack, and Fogliasso, 1998).

Believability of advertising claims influences purchase intentions (PI) and attitudes (Holbrook, 1978). Information that enhances perceptions of credibility and quality has also been shown to improve attitude toward the advertisement (AAD), attitude toward advertisement claims (AADC) and attitude toward advertisement visuals, and PI when included in advertisements for other financial services, such as automobile insurance (Clow, James, Kranenburg, and Berry, 2006). However, informativeness has no main effect on attitude toward the brand (AB) or PI (Kamins and Marks, 1987).

Many advertising researchers hold that more information is better (Abernethy and Franke, 1998; Pollay, 1986). However, greater amounts of information in advertising also have been shown to discourage consumers from reading information (Franke, Huhmann and Mothersbaugh, 2004). Unfortunately, the information load in marketing communications for financial services is much greater than that for tangible goods due to the complex presentation

and the lack of full disclosure of important details (Chang and Hanna, 1992; Hill and Kozup, 2007; Huhmann and Bhattacharyya, 2005). Financial industry marketing communications (e.g. mutual fund advertisements, credit card solicitations, securities prospectus) provide a great deal of information that largely is required by regulations, but is difficult to comprehend by consumers with poor financial numeracy. In this paper, we use experimental methods to understand the role of informativeness in advertising for mutual funds.

III. Method

For our experiment, we created two versions of an advertisement for a fictitious mutual fund. Stylistic properties and copy length mimicked actual mutual fund advertisements that appear in investor-oriented periodicals, such as *Barron's*. The two versions were identical in all respects except that the text of one version was written to convey the relevant risk-return, transaction cost and agency information that financial theory holds that potential investors should value when making investment decisions ("the treatment advertisement"); whereas the other version did not have any specific financial information ("the control advertisement"). The two advertisements are placed in appendix for ready reference. This technique is similar to that in Holbrook (1978) who manipulated advertisement claims about a foreign car or Kamins and Marks (1987) who manipulated advertisement claims about a ballpoint pen. The two advertisements are placed in the Appendix for ready reference.

A. Subject Pool Characteristics.

Undergraduate students at two major North American universities viewed the advertisement. Table 1 summarizes sample characteristics for the 294 valid responses.

Table 1: Demographic Characteristics

Age in Years	Mean	21.51
	Median	21
	Standard Deviation	3.7
	Maximum	50
	Minimum	17
Gender	Male	54.4%
	Female	45.6%
Ethnicity	White	61.6%
	Asian	21.8%
	Hispanic	5.4%
	Black	3.1%
	Others	8.1%

Citizenship	Canada	63.3%
	US	17.0%
	Others	19.7%
Native English Speakers		74.1%
Percent exposed to the treatment ad		49.7%

B. Procedure.

Each subject saw only one advertisement, either the treatment or control version of the advertisement. The treatment version contained the relevant risk-return, transaction cost and agency information. Versions were randomly assigned. Subjects then completed a questionnaire containing 7-point scale measures of dependent and independent variables and some demographic identifiers. Also, manipulation check items were completed to verify that subjects were, in fact, able to discern differences in the presence of risk-return information, transaction cost information, and agency information between the informative treatment and the uninformative control version of the advertisement. See Table 2 for a description of each variable and its measurement reliability where appropriate.

C. Regression.

Our empirical methodology is to examine the effect of mutual fund information on the dependent variables using multiple regression analysis. Our objective is to find out whether and in what manner financial information in the mutual fund advertisement influence the investor decisions. Specifically we estimate thirteen regressions. Each of the regressions has the same set of independent variables. The form of a regression equation is as below:

$$\begin{aligned} \tilde{Y} = & \beta_0 + \beta_{DUM} DUM_MUFU + \beta_{NFC} NFC_MEAN + \beta_{RT} RT_MEAN \\ & + \beta_{GEND} DUM_GEND + \beta_{AGE} AGE + \beta_{DISB} DISB_MEAN + \beta_{MIST} MIST_MEAN \\ & + \beta_{ENG} ENG_YN + \beta_{WHITE} WHITE_YN + \tilde{\epsilon} \end{aligned} \quad (1)$$

where

\tilde{Y} is the dependent variable. We run thirteen regressions. So there are thirteen dependent variables. These are RISK_MEAN, USEF_MEAN, AB_MEAN, PI_MEAN, RECO_MEAN, WOM, RETN_MEAN, AAD_MEAN, AADC_MEAN, AADP_MEAN, MCRR_MEAN, MCTC_MEAN, MCAG_MEAN. Table 2 describes these dependent variables.

And

$\tilde{\epsilon}$ is the random error term.

Table 2: Independent and Dependent Variables

<u>Independent Variables</u>	
<i>DUM_MUFU</i>	A manipulated dummy variable that indicates whether the subject was exposed to the control (0) or informative treatment (1) version of the advertisement.
<i>NFC_MEAN</i>	Cacioppo, Petty, and Kao's (1984) 18-item need for cognition scale (coefficient alpha = .86).
<i>RT_MEAN</i>	Raju's (1980) 9-item degree to which a subject is a risk taker scale (coefficient alpha = .79).
<i>DUM_GEND</i>	A dummy variable for gender indicating whether the respondent is male (1) or female (0).
<i>AGE</i>	Age of the respondent in years.
<i>DISB_MEAN</i>	Boush, Friestad, and Rose's (1994) skepticism toward advertising subscale that measures subjects' disbelief of information in an advertisement (coefficient alpha = .79).
<i>MIST_MEAN</i>	Boush, Friestad, and Rose's (1994) skepticism toward advertising subscale that measures subjects' mistrust of advertising claims and advertisers' motives. Coefficient alpha (.52) was near the lower end of the range (.58 to .73) reported by Boush, Friestad and Rose (1994) in their administrations of the mistrust subscale.
<i>ENG_YN</i>	A dummy variable equal to 1 for native English speakers and 0 for others.
<i>WHITE_YN</i>	A dummy variable for ethnicity equal to 1 for White respondents and 0 for others.
<u>Dependent Variables</u>	
<i>RISK_MEAN</i>	Mean of four items measuring perceived investment risk for the advertised mutual fund (coefficient alpha = .87).
<i>USEF_MEAN</i>	Mean of three items measuring perceived usefulness of information in the mutual fund advertisement (coefficient alpha = .66).
<i>AB_MEAN</i>	Mean of three brand attitude items (coefficient alpha = .93).
<i>PI_MEAN</i>	Mean of three purchase intention items (coefficient alpha = .93).
<i>RECO_MEAN</i>	Mean agreement with two brand recommendation items regarding recommending the advertised mutual fund to someone looking to invest (correlation = .95).
<i>WOM</i>	Mean single-item positive word-of-mouth likelihood rating.
<i>RETN_MEAN</i>	Mean of three-item measure of the respondent's belief that the mutual fund will provide a higher return (coefficient alpha = .75).
<i>AAD_MEAN</i>	Mean overall attitude toward the advertisement (coefficient alpha = .93)..
<i>AADC_MEAN</i>	Mean of Miniard, Bhatla, and Rose's (1990) attitude toward the advertisement claims scale (coefficient alpha = .86).
<i>AADP_MEAN</i>	Mean of Miniard, Bhatla, and Rose's (1990) attitude toward peripheral cues in the advertisement scale. Peripheral cues are the parts of the advertisement other than the claims. Examples include a non-informative picture, a logo, or the type font (coefficient alpha = .94).
<i>MCRR_MEAN</i>	Mean of the three-item risk-return information manipulation check (coefficient

alpha = .80).

<i>MCTC_MEAN</i>	Mean of the three-item of transaction cost information manipulation check (coefficient alpha = .66).
<i>MCAG_MEAN</i>	Mean of the three-item agency information manipulation check (coefficient alpha = .88).

We are most interested in the coefficient of DUM_MUFU. This coefficient will tell us if relevant information in the mutual fund advertisement affects the respondents' perceptions, evaluation, and intentions and the nature of that effect. The other independent variables are incorporated to ensure that results are robust after controlling for various independent variables.

IV. Results

A. Descriptive statistics

Table 3 presents descriptive statistics for the dependent variables and for the non-dummy independent variables. Descriptive statistics include the median, mean, standard deviation and the range (i.e., the minimum and maximum value) for each variable.

Table 3: Descriptive Statistics

Name	N	Mean	Median	Standard Deviation	Minimum	Maximum
<u>Non Dummy Independent Variables</u>						
NFC_MEAN	293	4.73	5	0.80	3	7
RT_MEAN	293	3.72	4	0.99	1	7
AGE	294	21.51	21	3.70	17	50
DISB_MEAN	294	5.52	6	0.97	2	7
MIST_MEAN	291	5.37	5	0.84	1	8
<u>Dependent Variables</u>						
RISK_MEAN	294	4.67	5	1.18	1	7
USEF_MEAN	294	3.19	3	1.24	1	7
AB_MEAN	293	4.48	5	1.23	1	7
PI_MEAN	294	4.17	4	1.44	1	7
RECO_MEAN	294	3.74	4	1.68	1	7
WOM	294	4.86	5	1.66	1	7
RETN_MEAN	293	3.67	4	1.09	1	7
AAD_MEAN	294	4.15	4	1.29	1	7
AADC_MEAN	294	4.13	4	1.27	1	7

AADP_MEAN	294	4.19	4	1.48	1	7
<u>Manipulation Checks</u>						
MCRR_MEAN	294	3.30	3	1.48	1	7
MCTC_MEAN	293	2.97	3	1.44	1	7
MCAG_MEAN	293	4.45	4	1.22	1	7

B. Results of Regression Analyses.

The correlation coefficients between the non-dummy independent variables are given in Table 4. The correlations are low, thus confirming absence of multi-collinearity. Regression results are provided in Table 5.

Table 4: Correlation Coefficients Between Non-dummy Independent Variables

	NFC_MEAN	RT_MEAN	AGE	DISB_MEAN	MIST_MEAN
NFC_MEAN	1.00				
RT_MEAN	0.13	1.00			
AGE	0.19	0.15	1.00		
DISB_MEAN	0.14	0.08	0.08	1.00	
MIST_MEAN	0.01	0.02	0.01	0.05	1.00

Table 5: Regression Results

Predictor	Dependent Variables				
	RISK_MEAN	USEF_MEA	AB_MEAN	PI_MEAN	RECO_MEAN
DUM_MUFU	0.77***	0.36***	-0.15	-0.26	-0.24
NFC_MEAN	0.02	-0.06	-0.05	0.02	-0.18
RT_MEAN	-0.01	-0.06	-0.10	-0.20**	-0.01
DUM_GEND	-0.16	0.25*	0.14	-0.11	-0.24
AGE	0.02	-0.02	-0.04**	-0.09***	-0.06**
DISB_MEAN	0.02	-0.15*	-0.06	-0.08	-0.12
MIST_MEAN	0.08	-0.01	0.06	0.11	0.01
ENG_YN	0.2	0.04	0.47***	0.29	0.29
WHITE_YN	-0.22*	-0.48***	0.00	-0.22	-0.43**
CONSTANT	3.33***	5.06***	5.69***	6.67***	6.78***
N	289	289	288	289	289

R² 11.5% 9.94% 7.08% 10.35% 7.64%

*Significant at 10% level, **significant at 5% level and ***significant at 1% level.

Table 5: Regression Results (Continued)

Predictors	Dependent Variables				
	WOM	RETN_MEAN	AAD_MEAN	AADC_MEA	AADP_MEAN
DUM_MUFU	-0.30	0.29**	0.03	0.23	0.12
NFC_MEAN	-0.15	0.02	0.00	-0.07	0.06
RT_MEAN	0.00	-0.03	-0.24***	-0.09	-0.26***
DUM_GEND	0.03	-0.06	-0.06	0.16	-0.02
AGE	0.02	-0.04**	-0.06***	-0.06***	-0.06***
DISB_MEAN	-0.02	-0.16**	-0.02	-0.04	0.05
MIST_MEAN	0.20	-0.02	0.01	-0.04	-0.11
ENG_YN	0.11	0.21	0.42**	0.58***	0.47**
WHITE_YN	0.38*	-0.06	-0.28*	-0.23	-0.24
CONSTANT	3.98**	5.28***	6.21***	6.13***	6.24***
N	289	288	289	289	289
R ²	3.65%	6.72%	10.1%	10.55%	9.57%

*Significant at 10% level, **significant at 5% level and ***significant at 1% level.

C. Manipulation Checks.

Looking at the manipulation checks, the subjects were able to discern differences between the informative advertisement and the uninformative advertisement. Paired comparisons show that the means are significantly different in the expected pattern for the two advertisements. The informative advertisement ($\bar{X} = 3.96$) was rated higher in terms of the presence of risk-return information than the uninformative advertisement ($\bar{X} = 2.64$; $t = 8.626$, $df = 292$, $p < .001$). The informative advertisement ($\bar{X} = 4.24$) was also rated higher in terms of the presence of transaction cost information than the uninformative advertisement ($\bar{X} = 1.96$; $t = 14.268$, $df = 291$, $p < .001$). Finally, the informative advertisement ($\bar{X} = 4.71$) was rated higher in terms of the presence of agency information than the uninformative advertisement ($\bar{X} = 4.22$; $t = 3.612$, $df = 291$, $p < .001$).

The regressions with dependent variables measuring manipulation checks pertaining to risk and return, (MCCR_MEAN), transaction cost (MCTC_MEAN) and agency aspect (MCAG_MEAN) all have significant coefficient for the DUM_MUFU variables (see Table 6). This shows that respondents viewing the informative advertisement do process the relevant

information. This enhances the robustness of the results of our experiment.

Table 6: Multiple Regression Analyses on Manipulation Check Variables

Predictors	Dependent Variables		
	MCRR_MEAN	MCTC_MEAN	MCAG_MEAN
DUM_MUFU	1.31***	1.80***	0.40***
NFC_MEAN	0.10	0.02	0.10
RT_MEAN	-0.08	-0.04	-0.17**
DUM_GEND	0.02	0.19	0.12
AGE	-0.04*	0.00	-0.06***
DISB_MEAN	-0.10	-0.12	-0.12*
MIST_MEAN	-0.02	-0.09	0.09
ENG_YN	0.03	0.36**	0.03
WHITE_YN	-0.37**	-0.32**	-0.13
CONSTANT	4.18***	3.05***	5.80***
N	289	288	288
R ²	23.51%	42.20%	10.81%

*Significant at 10% level, **significant at 5% level and ***significant at 1% level.

V. Discussion

As mentioned earlier, the coefficient of interest in this regression is DUM_MUFU, the dummy variable that captures whether the respondent was shown the version of the advertisement containing financial information. The coefficients of DUM_MUFU are significant at 1% level in 6 out of the 13 regressions run. The dependent variables in the seven regressions where the coefficients of DUM_MUFU are significant are RISK_MEAN, USEF_MEAN, RETN_MEAN, MCRR_MEAN, MCTC_MEAN and MCAG_MEAN.

For the regressions with dependent variables RISK_MEAN and RETN_MEAN, the coefficients of the DUM_MUFU term are 0.77 and 0.29 respectively. This indicates that respondents who viewed the informative version considered the mutual fund to be both risky and generating some return. However, when the dependent variable is RISK_MEAN, the DUM_MUFU coefficient is 2.6 times what it is when the dependent variable is RETN_MEAN. *Thus, respondents who view an informative advertisement tend to associate a higher risk to the advertised mutual fund.* This would explain why Huhmann and Bhattacharyya (2005) found that mutual funds in many cases were hesitant to put risk-return information in their advertisements.

Respondents also find informative advertisements to be useful. This is supported by the fact that when the dependent variable is USEF_MEAN, the coefficient of the DUM_MUFU is 0.36 and is significant at 1% level. It is also clear from the results that factors other than the information contained in an advertisement also enter into an investor's decision making process. This follows from the fact that none of the other regressions with the dependent variables of AB_MEAN, PI_MEAN, RECO_MEAN, or WOM have a significant DUM_MUFU coefficient.

However, overall attitude to the advertisement is positively influenced by advertisement information. We can infer this by noting that when the dependent variable is AAD_MEAN, the DUM_MUFU coefficient is positive and significant a 1% level of significance. This is a paradoxical result because when the dependent variable involves either attitude towards advertisement claims or peripheral cues (i.e., AADC_MEAN or AADP_MEAN), the DUM_MUFU coefficient is not significant. This paradox is for future research to resolve.

One limitation of the current experiment is the use of student subjects. Although some question the use of student subjects, Hovland (1959) concluded that student and non-student sample methodologies produce similar results. A more recent meta-study by Peterson (2001) did not find any systematic patterns of differences between student and adult subjects, but did suggest that caution should be used when generalizing from student subjects to the more general population. We suggest that future research should replicate these findings with a population of adult investors.

VI. Conclusions

We conducted this experiment in order to understand the paradox discovered by Huhmann and Bhattacharyya (2005) viz. that mutual fund advertisements do not contain all the information necessary for making financial decisions. We conducted an experiment and found that including financial information in a mutual fund advertisement increases perceived riskiness of the advertised mutual fund. This would explain advertisers' reluctance to include financially relevant information in mutual fund advertisements. Our results are also consistent with those of Jones and Smythe (2003) who found a decreasing amount of transaction cost information in mutual fund advertising.

This research can be extended in several directions. Our experiment included all the relevant financial information in one informative advertisement. A more fine-tuned experiment is possible in which the presence of a single type of financial information is manipulated to determine the impact of that information in financial service advertising on investment decisions or information processing. Another interesting extension of these results would be from the information processing aspect which would examine whether ads containing two or more types of financial information get selectively processed and if so, which type of financial information are preferentially processed. A related research question, important from a public policy perspective would be whether or not financial literacy training alters advertising information usage and attitudes. Results could help determine public policy on imparting financial literacy training to the general population.

References

- Abernethy, A.M. and Franke, G.R. (1998). FTC Regulatory Activity and the Information Content of Advertising. *Journal of Public Policy & Marketing*, 17(2), 239-56.
- Abernethy, A.M., Gray, J.I., and Butler, D.D. (1997). Radio Advertising Information Strategy: Differences between Services and Products. *Journal of Services Marketing*, 11(5), 344-357.
- Arya, A., Glover, J. and Rajan, U. (2000). Implementation in Principal-Agent Models of Adverse Selection. *Journal of Economic Theory*, 93(1), 87-109.
- Barber, B.M., Odean, T. and Zheng, L. (2005). Out of Sight, Out of Mind: The Effects of Expenses on Mutual Fund Flows. *Journal of Business*, 78 (6), 2095-2120.
- Boush, D.M., Friestad, M. and Rose, G.M. (1994). Adolescent Skepticism toward TV Advertising and Knowledge of Advertiser Tactics. *Journal of Consumer Research*, 21 (1) 165-175.
- Cacioppo, J.T., Petty, R.E. and Kao, C.F. (1984). The Efficient Assessment of Need for Cognition. *Journal of Personality Assessment*, 48 (3), 306-307.
- Chang, Y. R. and Hanna, S. (1992). Consumer Credit Search Behavior. *Journal of Consumer Studies and Home Economics*, 16 (3), 207-227.
- Chordia, T. (1996). The Structure of Mutual Fund Charges”, *Journal of Financial Economics*, 41 (1), 3-39.
- Clow, K.E., Baack, D. and Fogliasso, C. (1998). Reducing Perceived Risk through Advertising Service Quality Cues. *Journal of Professional Services Marketing*, 16 (2), 151-162.
- Clow, K.E., James, K.E., Kranenburg, K.E., and Berry, C.T. (2006). The Relationship of the Visual Element of an Advertisement to Service Quality Expectations and Source Credibility. *Journal of Services Marketing*, 20 (6), 404-411.
- Dellva, W.L. and Olson, G.T. (1998). The Relationship between Mutual Fund Fees and Expenses and their Effects on Performance. *Financial Review*, 33 (1), 85-103
- Fama, E.F. (1980). Agency Problems and the Theory of the Firm. *The Journal of Political Economy*, 88 (2), 288-307.
- Franke, G.R., Huhmann, B.A. and Mothersbaugh, D.L. (2004). Information Content and Consumer Readership of Print Ads: a Comparison of Search and Experience Products. *Journal of the Academy of Marketing Science*, 32 (1), 20-31.
- Grossman, S.J. and Hart, O.D. (1983). An Analysis of the Principal-Agent Problem”, *Econometrica*, 51 (1), 7-45.
- Hill, R.P and Kozup, J.C. (2007). Consumer Experiences with Predatory Lending Practices. *Journal of Consumer Affairs*, 41 (1), 29-46.
- Holbrook, M.B. (1978). Beyond Attitude Structure: Toward the Informational Determinants of Attitude. *Journal of Marketing Research*, 25 (4), 545-556.
- Holmstrom, B. (1979). Moral hazard and Observability. *Bell Journal of Economics*, 10 (1), 74-91.
- Hovland, C.I. (1959). Reconciling Conflicting Results derived from Experimental and Survey studies of Attitude Change. *The American Psychologist*, 14 (1), 8-17.
- Huhmann, B.A. and Bhattacharyya, N. (2005). Does Mutual Fund Advertising provide necessary Investment Information? *The International Journal of Bank Marketing*, 23 (4), 296 -316.
- Huang, C.F. and Litzenberger, R.H. (1988). *Foundations for Financial Economics*, North-Holland, New York, NY.
- Ingersoll, J.E. (1987). *Theory of Financial Decision Making*, Rowman & Littlefield, Totowa, NJ.

- Jain, P.C. and Wu, J.S. (2000). Truth in Mutual Fund Advertising: Evidence on Future Performance and Fund Flows. *Journal of Finance*, 55 (2), 937-958.
- Jones, M.A. and Smythe, T. (2003). The Information Content of Mutual Fund Print Advertising. *The Journal of Consumer Affairs*, 37 (1), 22-41.
- Jordan, J. and Kaas, K.P. (2002). Advertising in the Mutual Fund Business: The Role of Judgmental Heuristics in Private Investors' Evaluation of Risk and Return. *Journal of Financial Services Marketing*, 7 (2), 129-40.
- Kamins, M.A. and Marks, L.J. (1987). Advertising Puffery: The Impact of Using Two-Sided Claims on Product Attitude and Purchase Intentions." *Journal of Advertising* 16 (4), 6-15.
- Korkeamaki, T., Puttonen, V. and Smythe, T. (2007). Advertising and Mutual Fund Asset Flows. *International Journal of Bank Marketing*, 25 (7), 434-451.
- Livingston, M. and O'Neal, E.S. (1996). Mutual Fund Brokerage Commissions. *Journal of Financial Research*, 19 (22), 273-92.
- Livingston, M. and O'Neal, E.S. (1998). The Cost of Mutual Fund Distribution Fees. *Journal of Financial Research*, 21 (2), 205-18.
- Miniard, P.W., Bhatla, S. and Rose, R.L. (1990). On the Formation and Relationship of Ad and Brand Attitudes: An Experimental and Causal Analysis. *Journal of Marketing Research*, 27 (3), 290-303.
- Pellinen, A., Törmäkangas, K., Uusitalo, O., and Raijas, A. (2011). Measuring the Financial Capability of Investors: A Case of the Customers of Mutual Funds in Finland. *International Journal of Bank Marketing*, 29 (2), 107-133.
- Peterson, R. A (2001). On the Use of College Students in Social Science Research: Insights from a Second-Order Meta-Analysis. *Journal of Consumer Research*, 28 (3), 450-61.
- Petersen, J., Pietranico, P., Riepe, M. and Xu, F. (2001). Explaining the Performance of Domestic Equity Mutual Funds. *Journal of Investing*, 10 (3), 81-92.
- Pollay, R. (1986). The Distorted Mirror: Reflection on the Unintended Consequences of Advertising. *Journal of Marketing*, 50 (2), 18-36.
- Raju, P.S. (1980). Optimum Stimulation Level: Its Relationship to Personality, Demographics and Exploratory Behavior", *Journal of Consumer Research*, 7 (3), 272-282.
- Ramasamy, B. and Yeung, M.C.H. (2003). Evaluating Mutual Funds in an Emerging Market: Factors that matter to Financial Advisors. *International Journal of Bank Marketing*, 21 (3), 122 - 136.
- Ross, S.A. (1973). The Economic Theory of Agency: The Principal's Problem. *American Economic Review*, 63 (2), 134-139.
- Sirri, E. and Tufano, P. (1998). Costly search and mutual fund flows. *Journal of Finance*, 53 (5), 1589-622.
- Tasari, C.O., Bolton, R.N., Hutt, M.D., and Walker, B.A. (2011). Balancing Risk and Return in a Customer Portfolio. *Journal of Marketing*, 75 (2), 1-17.
- Yankow, J.J., Smythe, T.I., Lesseig, V.P. and Jones, M.A. (2011). The Impact of Advertising on Fund Flows in Alternative Distribution Channels. *International Journal of Financial Research*, 2 (1), 2-22.

Appendix



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BOINANZA Focused Growth Fund

How can you retire early?

It's not as impossible as you think. And it's not about lots of complicated math. It's all about thinking differently. You can do it with help from the Boinanza Focused Growth Fund.

You need a fund that takes a focused approach to investing by selecting the stocks that are best poised for growth. Our fund managers, Edward J. Conetti and Rita Dugald, are both previous winners of the prestigious *Standard & Poor's BusinessWeek Excellence in Fund Management Award*. Keep your long-term goals in focus and choose a fund whose managers keep their focus, too.

Best of all, our fund has a back-load sales commission, so you pay nothing up front as well as some of the lowest management (1.34%) and custodial fees (0.57%) in the industry. It doesn't get any better than this for reaching for your retirement goals.

Consult with your financial advisor or call 1-800-730-8913 (ext. 357) for additional information and a free copy of the prospectus. Also, call today for our free guide on how to retire early.

Why Choose Boinanza?

- Our fund managers, Edward J. Conetti and Rita Dugald, are both previous winners of the prestigious *Standard & Poor's BusinessWeek Excellence in Fund Management Award*.
- Our fund has a back-load sales commission, so you pay nothing up front as well as some of the lowest management (1.34%) and custodial fees (0.57%) in the industry.
- Higher returns generally accompany higher risk. This fund is more exposed to individual stock volatility and market pressure than a fully diversified fund. Therefore, it is expected to have a higher return.

1 ♦ 8 00 ♦ 730 ♦ 8913

This fund is non-diversified, meaning it may concentrate its assets in fewer individual holdings of specific stocks than a diversified fund. Therefore, the fund is more exposed to individual stock volatility and market pressure than a fully diversified fund. Higher risk accompanies higher returns.

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Figure 1: Treatment Advertisement with Risk-Return, Transaction Cost and Agency Information



BOINANZA

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It's not as impossible as you think. And it's not about lots of complicated math. It's all about thinking differently. You can do it with help from the Boinanza Focused Growth Fund.

You need a fund that takes a focused approach to investing by selecting the stocks that are best poised for growth. Our fund managers stick to their disciplines -- no matter what the latest "hot" trends may be. Keep your long-term goals in focus and choose a fund whose managers will keep their focus, too.

Our strategy seeks growth through focus on what is right for the customer. It is designed to create a fund that you will feel confident and comfortable investing in. It doesn't get any better than this for reaching for your retirement goals.

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Why Choose Boinanza?

- Our fund managers stick to their disciplines -- no matter what the latest "hot" trends may be.
- Our strategy seeks growth through focus on what is right for the customer. It is designed to create a fund that you will feel confident and comfortable investing in
- Our fund is one of the most talked about funds in the market today. We have more extended families among our customers than most other comparable firms.

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Figure 2: Control Advertisement with No Risk-Return, Transaction Cost nor Agency Information

On the Equivalent Annual Cost Method

Dan Han, Howard Qi and Alice Xie

Abstract

The equivalent annual cost (EAC) method is a useful tool in asset pricing, lease financing and corporate investment. It deals with projects with different economic lives and has wide applications in many fields outside the finance or even business. However, the important EAC concept and its applications are not always very well understood even within the finance academia. There are a few misunderstandings surrounding ¹this widely taught and practiced methodology as evidenced by our experience with finance professionals over the past decades and the lack of clarity in all the mainstream textbooks we have surveyed. One of them is the misconception that the EAC method requires infinite time horizon and infinite repetitions of the identical project or equipment. Given its importance and wide application, the finance profession has an obligation to serve well its gatekeeper role by not overlooking these misconceptions. Thus far, no one has raised and addressed these misconceptions. We fill in this void by explicitly revealing, explaining and addressing these misconceptions. Specifically, we argue that infinite horizon is a convenience but not a necessity by showing how the method can be used for projects or assets with finite horizons and what cautions one has to take. We also provide threads for future studies along this line. Our work makes a marginal contribution the finance theory, pedagogy and practice.

I. Background

The equivalent annual cost (EAC) method is a very useful corporate investment tool when we deal with mutually exclusive assets with different economic lives. The notion of EAC is an alternative to the traditional NPV rule but with its own additional benefits. For example, it helps us determine the costs in an average sense and identify alternative financing schemes such as debt arrangement, and lease financing. The EAC method may be called differently under different circumstances, such as the equivalent annuity, equivalent annual benefit, equivalent annual cash flows, etc. The essence of these variations is identical – to smooth out an uneven stream of cash flows for a finite period on the time line thereby allowing us to be able to make better comparisons among available options. In this study, we focus on the cost analysis, hence we use the acronym EAC, and refer to it as the EAC method. The points we make in this paper about the EAC method apply to all equivalent cash flow method.

The EAC methodology has long been part of standard finance education at many business schools and it also has wide applications outside the finance profession. However, surveying the literature in finance pedagogy, research and practice, we find misunderstandings and potential traps in this seemingly straightforward method. From our interactions with the academia, practitioners and educators, we are more convinced that these misunderstandings are deeply rooted and it appears increasingly necessary for the finance profession and educators, as

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the gate-keeper, to clarify this important concept. In this study, we fill this gap by specifically making two clarifications, (1) infinite horizon is *not* required for the EAC method to be valid or applicable; (2) the matching EAC stream should not start at any point in time.

By helping to make the EAC methodology more accurate, we make a marginal, yet long over-due, contribution to the finance education, research and practice.

II. Literature Review

In corporate investment and many other areas, we frequently encounter situations where we need to compare two assets with different economic lives. For this purpose, the well-known NPV rule has limitations as mentioned in Brealey, Myers and Allen (2013) because it does not consider the length of the asset's life span and uses the aggregate value. An asset may cost very little annually to maintain, but if its economic life is very long, the total accumulative cost over its entire life span can be astounding. Having very low maintenance costs and long economic life normally would be two desirable advantages, but once we combine them, the NPV method tends to yield an undesirable result because it is large in aggregate which overlooks the true benefit of lower annual costs and thereby distorting the correct decision making process and the non-optimal final result may be obtained. For example, Brealey, Myers and Allen (2011) shows such an example. For detailed discussion, see pages 155-160 of it. The EAC method helps us avoid this potential fallacy by using a different measure that is more intuitive – evenly spreading the total costs (or NPV) on an annual basis. There is another benefit to the EAC method in addition to the intuitive facility, that is, it can help us determine the equivalent leasing financing. The latter would have both theoretical and practical value because in some real-world situations, the firm may not be able to come up with enough cash to cover some cash flow liabilities even though the entire project is profitable. In this case, arranging leasing financing or some debt arrangement with a bank would be of vital practical value. The EAC method becomes very convenient to suit these goals. Welch (2009) mentions lease financing in this context, and shows that there exist many equivalent leases with payments starting at any point as one desires. While in Brealey and Myers (1996), Brealey, Myers and Allen (2011, 2013), etc. infinite horizon is the default assumption, i.e., once an asset is chosen, the same type of asset will be forever used and new replacement comes when the old one draws close to the end of its economic life. In some other finance literature, infinite horizon is taken explicitly as a necessity for the EAC method (see, e.g., Besley and Brigham, 2007). Similar EAC treatment is found in other mainstream texts, such as Berk, DeMarzo and Harford (2009) which calls the method the Equivalent Annual Annuity (EAA) method. Berk and DeMarzo (2007) very briefly introduce the same idea to measure project's profitability and call it "the equivalent annual benefit method" and show how to use it to pick a better project when multiple positive NPV projects have different economic lives. These, among many mainstream textbooks, do not explicitly clarify the methodology regarding its applicability and the difference in handling infinite and finite horizons.

Outside the finance area, the EAC method has also found many applications. For example, Kahraman and Kaya (2008) mention its application in a study of fuzziness and soft computing. As early as 1960 Ronald Coase applied the idea in his studies on legal issues and property right (Coase, 1960), and as well as other social science studies (e.g., Caulkins, 2010; Schmitt, 2013). Drummon, Stoddart and Torrance (1987) use the EAC method in their studies of

healthcare. Stamuli et al. (2012) apply the principle in their medical research. In the area of environmental research, the method is used in Ranjan and Kayshik (2013) evaluate solar distillation and environment degradation, and in Uihlein and Eder (2009) to policies to improve the environmental performance of building. Venkat (2011) uses the EAC method to investigate food wastes in the United States. Perman et al. (2011) apply the method to resource allocation in dealing with hypertension management for elderly population. Collins and Singhal (1995) show how to apply the EAC concept in the mining industry. Hopp and Darby (1980) use the concept to analyze indirect energy savings for household water conservation. As the movement of green and alternative energy is gaining popularity globally, the EAC method finds its new application as well, such as Krohn, Morthorst and Awerbuch (2009) which analyze the economics of wind energy for the European Wind Energy Association.

Therefore, from application viewpoint, the EAC method already has wide applications in many areas even completely outside the traditional finance area, which means that our finance academicians especially finance educators need to make an effort to ensure that this fundamental concept is accurate in theory and appropriate in practice.

III. The Traditional EAC Method

Now we use an example to illustrate the EAC method and its application to the infinite horizon. Suppose that a firm is facing two choices in picking machines to invest. We also assume, for simplicity, that the two machines only differ in annual cost and economic life. They produce identical consumer goods without any physical or quality differences. In fact, we can relax this assumption of consumer goods because this method is independent of what actual product we are facing. What ultimately matters is the associated cash flows. By using “identical consumer goods”, we really intend to mean that the cash flows of revenues are identical in terms of amount and risks. Therefore, instead of focusing on the net cash flows, we may just focus on the costs only. Machine A lasts for 4 years and machine B for 6 years. We wish to emphasize that given this context, the physical production is assumed to be not affected by the type of the machine that is chosen in the sense that, on an annual basis, identical products will be produced regardless of the machine type, in terms of quality and annual quantity. Assume that the appropriate discount rate for both is the same, $r = 10\%$. The cost cash flows from maintaining and running them are listed in Table I.

Table I. Cost cash flows from two mutually exclusive machines, A and B.

Year	0	1	2	3	4	5
A	\$10	\$7	\$12	\$18		
B	\$5	\$6	\$15	\$12	\$9	\$17

It is easy to find out that machine A would cost \$39.81 in present value to run over a 4-year life span, while machine B costs \$48.57 in present value. In terms of the total present value, machine A is superior because it costs less. But once we notice that machine A will have to be replaced (2 years) sooner than machine B, then the conclusion based on the total cost become problematic. To address this flaw, we spread the total cost evenly over the life span of the machine via the following relationship,

$$EAC = PV \times \frac{r}{1+r} \left(1 + \frac{1}{(1+r)^N} \right)^{-1}$$

which is obtained using the N -year annuity-due formula, where EAC is the equivalent annual cost, N is the number of years within the cycle of the cost cash flow stream. Here we define the cycle of the cost cash flows to be the repeating group of cash flows. Take machine A for example, if the first cash flow of \$10 would reoccur in year 4 hence leaving neither empty years nor overlap between the streams of costs associated with two machine A's, one replacing the other, then N would be 4. If machine B is treated in the same way, then N would be 6 for B. If there is overlap, then N will be reduced. Given this understanding, we find $EAC = \$11.42$ for machine A and $EAC = \$10.14$ for machine B, therefore, B is better than A because on average, it costs less to operate.

Thus far, everything makes sense and the implementation is straightforward. However, if the EAC method is only valid for such a simple environment where once a machine is chosen, it will repeat forever, then this method would not have much of a use in reality. This is so-called infinite horizon requirement. Indeed, many in the finance profession critique the EAC method for having little value exactly because of this overly restrictive assumption. Therefore, we raise the question whether this is indeed true or it is a misconception.

IV. Finite Horizon and the EAC Method

The EAC method actually can handle finite horizon situations even though some additional issues may arise accordingly. Now we use some examples to illustrate. In the following examples where machines C and D are under consideration, we stick to the same assumptions that they only differ in type, annual costs, and their expected economic lives. The annual production is completely independent of the machine type that we choose. This vital assumption guarantees the annual cash flows of revenues are not affected hence not part of the consideration. This allows us to focus on the annual costs and the expected economic lives, and investigate how these two factors would impact our decision making.

4.1 A special case of rigid finite horizon

Consider a firm that is facing a choice between machine C and D. Machine C lasts for 4 years, and D for 2 years. Suppose after 4 years, a new machine will be used regardless of whether C or D is chosen now. Machine C's and D's costs are given in Table II.

Table II. Cost cash flows from two mutually exclusive machines, C and D.

Year	0	1	2	3
C	\$14	\$12	\$10	\$30
D	\$8	\$20		

In this case, we have finite horizon, that is, 4 years. Within the first 4 years, we have some flexibility in our decision. Notice, this is a special case where machine D covers exactly 4 years, and machine B can be repeated once to make its operation exactly 4 years long. The

situation becomes what is described in Table III.

Table III. Cost cash flows from machines, C and D with D repeated once.

Year	0	1	2	3
C	\$14	\$12	\$10	\$30
D	\$8	\$20	\$8	\$20

We find the results are $EAC = \$15.98$ for machine C, and $EAC = \$13.71$ for machine D. Notice, for machine D, we may consider it to have a two-year cash flow cycle and one repetition or a four-year cycle with no repetition as if were a new machine that has a 4-year economic life. Either way, the EAC method nicely handles a finite horizon situation. Indeed, we acknowledge that this special situation might be too restrictive. Next, we relax these assumptions even more and show how the EAC method can be further extended.

4.2 A case of flexible finite horizon

Now assume the choice is between machine E and F. Machine E lasts for 3 years, and machine F for 2 years. As assumed earlier, the annual physical production is completely independent of the specific machine type that is implemented. This assumption is to guarantee that the revenue cash flows on an annual basis remains completely unaffected by the machine type and therefore the optimality decision making process can 100 percent concentrate on the annual and total costs and the expected economic life of the machine. Appropriate discount rate is $r = 10\%$. Table IV shows their annual costs.

Table IV. Cost cash flows from machines, E and F.

Year	0	1	2
E	\$11	\$3	\$8
F	\$5	\$10	

Suppose that the firm will choose a new technology regardless of whether E or F is chosen at the present time, and when to adopt the new technology has some flexibility – it can choose any time to adopt it after year 5. In this case, we can create a situation where machine E and F can be repeated different numbers of times before a common horizon. In other words, if we can choose a horizon T for both E and F such that it is divisible by the life span of the both machines, we would be able to create something similar to the example in the previous section, i.e., the two machines' horizons can match each other. Specifically, say, to meet a 6-year horizon, we can repeat machine E twice and machine F 3 times as shown in Figure 1.

Thus, we may consider what we have created is a 6-year quasi-cycle that contains using E twice and F three times. Setting $N = 6$, and equating the PV of the costs encircled in the quasi-cycle, at $r = 10\%$, we find $EAC = \$7.38$ for machine E and $EAC = \$7.44$ for machine F. Therefore, machine E costs less on an annual average basis.

We note that these results remain the same if we treat machine as a 3-year cycle and machine F as a 2-year cycle, respectively. This means that the EAC method can perfectly apply

to some finite horizon situations as long as we are allowed the flexibility to match the horizons as we have just done. In fact, if we have enough flexibility as such, the EAC method can be applied as long as we create a horizon that contains multiples of life spans of the machines.

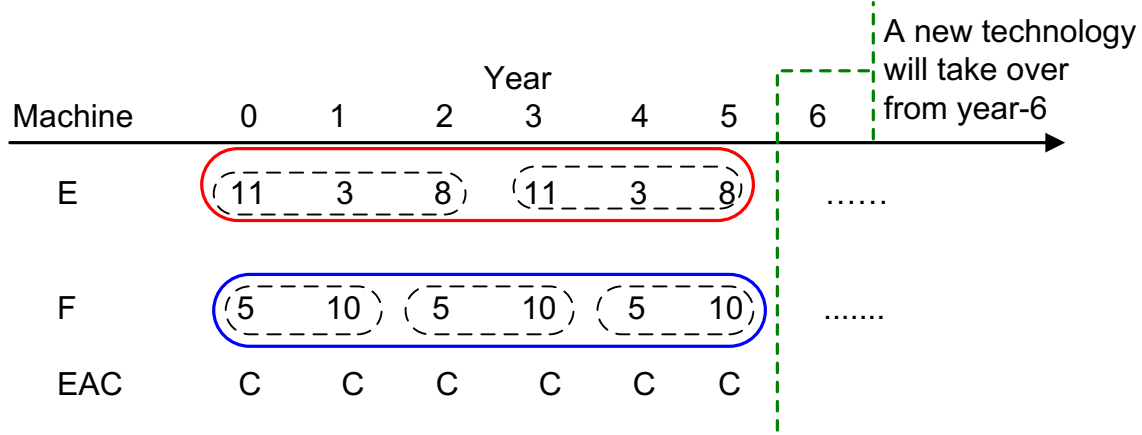


Figure 1. Using E twice and F three times creates the horizons that perfectly match.

Nevertheless, the flexibility we enjoy in this section is still quite restrictive because of the requirement of matching the horizons by creating a quasi-cycle. Can we relax this requirement by allowing horizons to be unmatched? In other words, if we completely remove any requirement on the horizon, can we still have a valid EAC framework? The answer is yes. However, with arbitrary horizons, more complicated issues will have to be addressed in order to restore the validity of the EAC method. These issues include incidental cash flows and incremental cash flows, etc. Qi and Xie (2015) explain these additional issues and demonstrate how to consistently restore the validity of the EAC methodology to arbitrary horizons.

V. EAC Stream Can Start Anytime

The actual costs have to be specified clearly on the time line. In the examples we have used in this study, the equivalent annual costs are matched exactly on the time line to those actual costs. However, no one has argued that this is necessary. Instead, we find one textbook suggesting that the EAC stream of cost cash flows may start anytime according to our like. Welch (2009) shows that the EAC does not have to match the corresponding actual costs. The example Welch (2009) uses is about determining a lease contract that substitute owning the machine.

We note that this practice is correct in theory and in that specific context; however, it can cause considerable misleading claims that may eventually lead to wrong decisions. Even to put it lightly, if we allow the EAC stream to start anytime or not match the horizon of the corresponding actual costs, the reliability of the EAC method is cast under great concern. Now we use the same example in the above section to illustrate this point. This is shown in Figure 2.

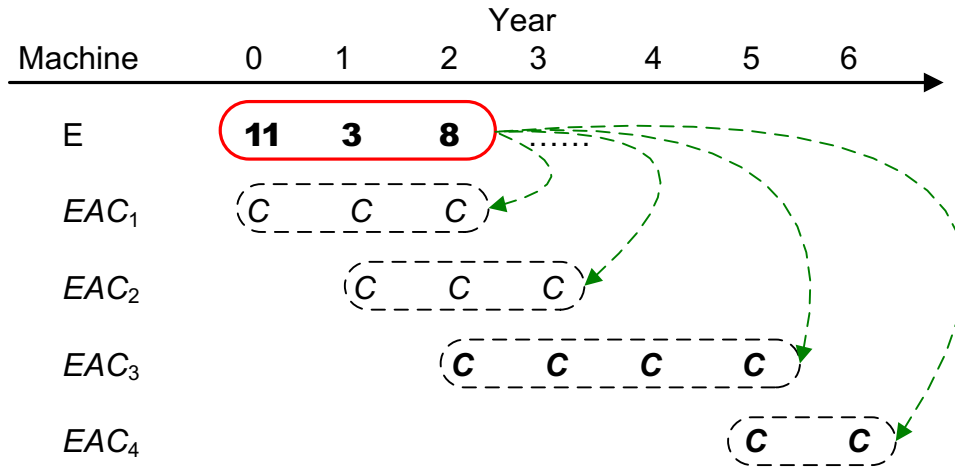


Figure 2. Machine E has three years of economic life. Here we show four equivalent annuities due starting at different times: two 3-year EAC’s (the first two cases, EAC_1 and EAC_2), and one 4-year and one 2-year EAC’s (the bottom two cases, EAC_3 and EAC_4).

The original 3-year cost cycle is now matched to four equivalent annuities due. At $r = 10\%$, PV of the costs of machine E from year-0 through year-2 is $PV_E = \$20.34$. Given the same present value of the costs, we find the equivalent annual costs as follows,

$$\left\{ \begin{array}{l} PV_E = \frac{EAC_1}{r} \left(1 - \frac{1}{(1+r)^3} \right) \times (1+r) \rightarrow EAC_1 = \$7.44 \\ PV_E = \frac{EAC_2}{r} \left(1 - \frac{1}{(1+r)^3} \right) \rightarrow EAC_2 = \$8.18 \\ PV_E = \frac{EAC_3}{r} \left(1 - \frac{1}{(1+r)^4} \right) \times \frac{1}{1+r} \rightarrow EAC_3 = \$7.06 \\ PV_E = \frac{EAC_4}{r} \left(1 - \frac{1}{(1+r)^2} \right) \times \frac{1}{(1+r)^4} \rightarrow EAC_4 = \$17.16 \end{array} \right.$$

Therefore, if we allow the EAC stream to start at any time and end at any point later on, then we would not have a unique equivalent annuity and the numbers can be “tuned” to pretty much any value, which makes comparing different machines a messy business because the numbers cannot be easily compare anymore. Nevertheless, we note that this calculation is handy for determining various possibilities of alternative lease financing. However, even though in theory one can do this, it would become a mess or misleading if we do so with even our simplest example of infinite horizon. Thus, we feel it is time to clarify that in a more generic environment, the stream of EAC cash flows should better match that of the corresponding actual costs.

VI. Conclusions

The equivalent annual cost (EAC) methodology is a powerful tool that is taught in business schools and has wide applications in many areas outside the field of finance. However, there are misunderstandings about it. In this paper, we clarify two common ones. The first is that the EAC method only applies to infinite horizon, i.e., once a type of machine is chosen, it will be forever used except that a new set replaces the old one once it reaches the end of the machine's economic life. The second is the notion that the matching EAC cash flows may start at any point and end at any time. For the first, we show a few counter examples that finite horizons may still be handled by the EAC method. For the second, we make a caveat that from a practical viewpoint, it is better to match the EAC cash flow stream to the corresponding actual cost cash flow stream. Our work on the EAC methodology helps make it more accurate and applicable to situations that are more realistic.

There are two other important factors that are not considered in this study but deserve further investigation. One is transaction costs and another one is that, given the advancement of technology, a shorter-life machine may have a hidden advantage of being able to be upgraded sooner – a greater extent of flexibility that may be characterized as a call option on real assets. We leave these relevant issues for future investigations.

References

- Berk, J., DeMarzo, P., & Harford, J. (2009). *Fundamentals of Corporate Finance*, 225-227, Pearson/Prentice Hall, Pearson Education, Inc. Boston, MA.
- Berk, J., & DeMarzo, P. (2007). *Corporate Finance*, 736-737, Pearson/Prentice Hall, Pearson Education, Inc. Boston, MA.
- Besley, S., & Brigham, E. F. (2007). *Essentials of Managerial Finance*, fourteenth edition, 443, South-Western College Publishing, Cincinnati, Ohio. Education, Inc. Boston, MA.
- Brealey, R. A., & Myers, S. C. (1996). *Principles of Corporate Finance*, fourth edition, 128, McGraw-Hill, The McGraw-Hill Companies, Inc., New York, NY.
- Brealey, R. A., Myers, S. C., & Allen, F. (2011). *Principles of Corporate Finance*, tenth edition, 155-160, McGraw-Hill/Irwin, The McGraw-Hill Companies, Inc., New York, NY.
- Brealey, R. A., Myers, S. C., & Allen, F. (2013). *Principles of Corporate Finance*, eleventh edition, pp. 146, McGraw-Hill/Irwin, The McGraw-Hill Companies, Inc., New York, NY.
- Ehrhardt, M. C., & Brigham, E. F. (2011). *Financial Management, Theory and Practice*, thirteenth edition, 406-408.
- Caulkins, J. P. (2010). Estimated cost of production for legalized cannabis, working paper, part of the Rand working paper series, Rand Drug Policy Research Center.
- Coase, R. H. (1960). The problem of social cost. *Journal of Law and Economics*, 3, 1-44.
- Collins, J.-L., & Singhal, R. K. (1995). Applications of the equivalent annual cost concept in mining. *International Journal of Surface Mining, Reclamation and Environment*, 9(1), 7-9.
- Drummond, M. F., Stoddart, G. L., & Torrance, G. W. (1987). *Methods for the Economic Evaluation of Health Care Programmes*, 48-51, Oxford University Press.
- Qi, H., & Xie, Y. A. (2015). Equivalent, Incidental and Incremental Cash Flows. *International Journal of Business, Accounting, & Finance*, forthcoming.
- Hopp, W. J., & Darby, W. P. (1980). Household Water Conservation: the Role of Indirect Energy Savings. *Energy*, 5, 1183-1192.
- Kahraman, C., & Kaya, I. (2008). Fuzzy Equivalent Annual-worth Analysis and Applications. *Fuzzy Engineering Economics with Applications Studies in Fuzziness and Soft Computing*, 288, 71081.
- Krohn, S., Morthorst, P.-E., & Awerbuch, S. (2009). *The Economics of Wind Energy*, A report by the European Wind Energy Association.
- Modigliani, F., & Miller, M. H. (1959). The Cost of Capital, Corporate Finance and the Theory of Investment. *American Economic Review*, 49(4), 261-297.
- Perman, G., Rossi, E., Waisman, G. D., Agüero, C., Gonzalez, C. D., Pallordet, C. L., Figar, S., de Quiros, F. G. B., Canning, J., & Soriano, E. R. (2011). Cost-effectiveness of a Hypertension Management Programme in An Elderly Population: a Markov Model. *Cost Effective and Resource Allocation*, 9(4), 1-11.
- Ranjan, K. R., & Kayshik, S. C. (2013). Economics Feasibility Evaluation of Solar Distillation Systems Based on the Equivalent Costs of Environmental Degredation and High-grade Energy Savings. *International Journal of Low-Carbon Technologies Advance Access*, 1-8.
- Schmitt, J. (2013). Why Does the Minimum Wage Have no Discernible Effect on Employment? Center for Economic and Policy Research, Washington, D.C.
- Stamuli, E., et al., (2012). Cost-effectiveness of Cryotherapy Verses Salicylic Acid for the Treatment for the Treatment of Plantar Warts: Economic Evaluation Alongside a Randomized Controlled Trial. *Journal of Foot and Ankle Research*, 5(4), 1-10.
- Uihlein, A., & Eder, P. (2009). Towards Additional Policies to Improve the Environmental

Performance of Building. *JRC Scientific and Technical Reports*, JRC European Commission

Venkat, K. (2011). The Climate Change and Economics Impacts of Food Waste in the United States. *International Journal of Food System Dynamics*, 2(4), 431-446.

Welch, I. (2009). *Corporate Finance*, 60-63, Pearson/Prentice Hall, Pearson Education, Inc. Boston, MA.

Corporate Governance and Firm Performance: Roles of Insider and Institutional Holdings

William Bosworth and Sharon K. Lee

Abstract

Over the last decade more attention has focused upon the corporate governance roles played by insiders and institutional holders of corporations. In particular, how effective is monitoring by institutional holders? Does share ownership by insiders provide incentive for managers to perform in ways that maximize shareholder wealth? Many financial studies examined these relationships over the past thirty years. Recently there has been a change in how the quality of a company's corporate governance is rated. Is the change in ratings systems by the ISS from GRids to Quickscores a good one? Is there a better "quick" indicator of good corporate governance? This paper provides additional evidence on the relationship between ownership structure and firm performance, and in doing so, shows that institutional and insider holdings may be better guides for investors than the "new and improved" ISS indicators.

I. Introduction

In an uncertain world, investors seek ways to identify "good" firms that are well-run and have managers seeking to maximize the wealth of their owners. During the past ten years, significant efforts have been made to determine the role of financial markets in minimizing agency costs. The first step in this process is to create or identify a measure or measures that accurately reflect(s) the quality of a company's corporate governance. Recently, the Institutional Shareholder Services, Inc. (ISS) changed their system of measuring the quality of corporate governance. For several years, the Governance Risk Indicators, or GRId's, as developed by the ISS were used to evaluate the risk of bad corporate governance. Now the ISS has developed a new system called QuickScores. Just as companies and investors become comfortable with the GRId "level of concern" approach, a new QuickScore quantitative approach rating companies in deciles has been adopted.

The ISS Governance QuickScore is based on correlations between governance factors and key financial metrics, and includes 181 variables. The ISS identified a set of important governance factors and depending on how well a company "measures up" with each of these factors, a company is given a "meet," "exceed," or "fall short" of market best practice. For each governance factor, ISS analyzed the correlation with 16 performance and risk factors" (ISS, 2013). The ISS reported "consistent and robust correlation between governance and performance factors" with high correlations for ROA and CFROI. The weights assigned to the variables is not reported by the ISS.

Brownstein et.al. (2013) conclude that rating companies in deciles can be misleading and counterproductive. By definition, half of all companies will be below average. It is possible that companies with minor corporate governance concerns may be labeled as having relatively "bad" governance practices in place. The new QuickScore system of rating companies in deciles may provide undue concern about a company that is not in the top five deciles.

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A score of 1 indicates relatively lower governance risk, and, conversely, a score of 10 indicates relatively higher governance risk. Companies receive an overall QuickScore and are also assessed across four pillars: Board Structure, Compensation/Remuneration, Shareholder Rights, and Audit. There appear to be significant differences between the former GRId system and the new QuickScore system in the specific ratings assigned to some companies. Some examples of these differences are:

- Apple, Inc. - GRId rating of “low risk” was given for the Compensation category, yet a “6” is given in that category by QuickScore,
- General Electric Co. – GRId rating of “low risk” was given for Board Structure, yet a “7” is given by QuickScore,
- Wal-Mart Stores Inc. – GRId rating of “low risk” was given for Board Structure, yet a “9” was given by QuickScore. In fact, an overall, rating of an “8” was given by QuickScore, where GRId rated Wal-Mart as having overall “low corporate governance risk”, and
- IBM – GRId rating of “low risk” was given in the Audit category, yet QuickScore gives the company the worst rating of “10” in that category.

These inconsistencies raise questions on the validity of both rating systems and how much importance investors should place on them. If a rating such as the QuickScore is viewed as the best measure for the markets to use in investment decisions management may have improvement of their “scores” as a primary goal, rather than fundamental decisions that add shareholder value. Should the QuickScore be the universally accepted method of labeling a company’s level of effectiveness in its corporate governance system? Are there publicly available measures that provide a better and clear proxy for a company’s quality of governance?

II. Background

Over the past two decades, numerous studies have examined the relationship between firm characteristics and firm performance, with several variables being identified as potential indicators of good performing firms. The independence of the board of directors, as well as insider ownership and institutional shareholdings has been examined. Several studies have addressed the importance of board independence as a predictor of good firm performance [Bhagat and Bolton, 2008; Lee and Carlson, 2007; Dahya and McConnell, 2002]. Lee and Carlson (2007) find that firms with the most independent boards have better firm performance. Dahya and McConnell (2005) examine firms that recently increased their board’s independence levels and find that those boards are significantly more likely to replace the CEO after a record of poor firm performance. Based upon this, we include the board independence measure in our examination.

We direct the focus to the important roles of insider and institutional holdings as effective corporate governance indicators. Berle and Means (1932) began the discussion of the existence of a “separation of ownership from control”, and warned of possible significant negative effects on companies and society as a whole if power is concentrated with managers and insiders. Jensen and Meckling (1976) discuss the potential reduction in agency costs if managers are also shareholders of the company. With their interest aligned with shareholders, managers may be motivated to make decisions that maximize shareholder wealth. Recent literature provides

evidence on the importance of insider and institutional holdings on firm value and firm performance. On the other hand, high insider ownership may create an entrenched management that feels too comfortable in their position (Morck et. al, 1988, Shleifer and Vishny, 1997). However, Morck et. al find a non-monotonic positive relationship between insider ownership and firm performance, as measured by Tobin's q . Leech and Leahy (1991) examine ownership structure and firm performance of nearly 500 U.K. firms, and do not find strong results supporting the shareholder-maximizing theory nor the management entrenchment theory.

Evidence on the relationship between institutional ownership and firm performance is mixed. Bhattacharya and Graham (2009) find that institutional investors with investment or business ties with the firm have a negative effect on firm performance. In an examination of takeover bid premiums, Duggal and Millar (1999) find a positive relationship between the level of institutional ownership and bidder gains. However, in two-stage regressions when bidder gains are regressed on institutional ownership, the estimates do not support the ordinary least-squares regression (OLS) results. Shareholders with significant ownership stakes may provide monitoring of management, enhancing firm performance (Schleifer and Vishny, 1986). Holderness (2009) finds that over 96% of U.S. Firms have at least one blockholder. A blockholder is defined as a shareholder with a minimum 5% stake. Blockholders, whether insiders or institutional, may also encourage good managerial decisions by selling their shares when bad decisions are made (Admati and Pfleiderer, 2009, Edmans and Manso, 2011, Nguyen et. al, 2013). Edmans and Manso (2011) find that with the presence of multiple blockholders, the effectiveness of an "exit", reducing or eliminating their stakes, is increased. The level of insider and/or institutional holdings may provide investors with a good indicator of corporate governance quality. The level of insider holdings may serve as an incentive for management to make decisions in the best interest of shareholders. This leads to good firm performance in that agency costs are minimized. On the other hand, the level of institutional holdings serves a monitoring function, where shareholders use the exit mechanism and "vote with their feet" in cases where bad managerial decisions were made.

We hypothesize that publicly available measures such as insider ownership and institutional can provide as good or better proxies for a company's quality of corporate governance, better than the 188-variable QuickScore rating system currently published by the ISS. Are the insider or institutional holdings "quick" indicators for investors to identify "good" vs. "bad" firm? Are they as good or better than QuickScores?

III. Data and Methodology

Sixteen (16) performance measures (as used in the ISS's QuickScore ratings) have been collected for S & P 500 firms as of June 2013, as well as insider holdings, institutional holdings, board independence levels, and QuickScores. Two measures, dividend one-year growth and stock price volatility, were omitted due to their inclusion in the ISS list of factors. The fourteen (14) performance measures are: One-year Shareholder Return, Tobin's Q , Cash Flow Return on Investment (CFROI), EBITDA Margin, Free Cash Flow to Sales (FCF/Sales), Net Profit Margin, Return on Assets (ROA), Return on Equity (ROE), Return on Invested Capital (ROIC), Sales Growth (one-year), Altman's Z Score, Market to Book, Price to Cash flow (Price/CF), and P/E ratio. These performance measures are collected from the *Compustat* database. Insider holdings,

Institutional holdings, and ISS QuickScores are collected from *Yahoo.Finance.com*. All mean performance measures are industry-adjusted and winsorized. By using the method of winsorizing, the effects of extreme values, or outliers, in the data are minimized. Our data is winsorized at $\pm 3 \sigma$.

The performance measures are tested using one-way ANOVA (F-tests) and regressions with both insider holdings and institutional holdings as explanatory variables. We hypothesize that insider holdings serves as a management incentive, and that institutional holdings serve to monitor management. Given evidence in the literature, these two variables, together or alone, may serve as better quick indicators than the QuickScore developed by the ISS. We estimate least-squares regressions, using each industry-adjusted performance measure as the dependent variable, and insider holdings, institutional holdings, QuickScore, and Total Average Assets as explanatory variables. Total Average Assets, divided by \$10 million, serves as a control variable, commonly done in governance literature, and is not industry-adjusted.

To test if of any of our potential governance proxies are related to an aggregation of performance measures as opposed to any particular one, we perform additional regressions, regressing the four proxies, board independence, insider holdings, institutional holdings, and the ISS QuickScore on the fourteen measures of firm performance (Table IV). One set of regressions is comprised of all 14 performance measures as independent variables, while the other set exploits the almost tautological relationship among performance measures suggested by financial reporting conventions. In particular, we recognize that Tobin's Q and the market to book ratio are similar; cash flow return on investment, return on equity, and return on assets are similar; EBITDA margin, free cash flow per sales, and net profit margin are similar; and finally, price to cash flow and price earnings are similar. A Pearson Correlations table between all the variables is created with 162 relationships. All of these relationships are used to reduce the number of regressors in the second set of regressions shown in Table IV.

IV. Results

The results indicate that there are significant relationships between many firm performance measures. Table I shows the results of the One-Way ANOVA of the industry-adjusted performance measures.

TABLE I
One-Way ANOVA Industry-Adjusted Performance Measures vs. Indicators of Corporate Governance (Board Independence, Insider Holdings, Institutional Holdings)
As of June 2013

Performance Measure	Industry Adjusted				Industry & Winsorized			
	Board Ind.	Insider Holdings	Institution	Quick Score	Board Ind.	Insider Holdings	Institution	Quick Score
1 Yr Return	0.904	2.236*	0.807	1.362	0.953	2.193*	0.932	1.241
Tobin's Q	2.177*	1.207	0.907	0.622	1.869*	1.127	0.981	0.606
CFROI	0.375	0.232	3.03*	0.871	0.51	0.546	2.268*	0.76
EBITDAM	1.285	0.965	1.234	0.846	1.285	0.965	1.234	0.846
FCF/Sales	0.359	0.348	0.871	0.993	0.345	0.368	0.932	1.002
NPM	1.024	1.468**	1.111	0.19	1.001	1.58**	1.369*	0.582
ROAA	1.251	1.591**	1.600*	0.538	1.324	1.246	1.354*	0.539
ROAEQ	1.279	0.017	0.441	1.084	1.279	0.017	0.441	1.084
ROI	0.592	1.306	2.177*	0.378	0.592	1.306	2.177*	0.378
SalesGrwth	1.019	2.215*	1.407	0.993	1.238	1.151	1.492*	1.064
Alt Z-Score	5.63*	1.11	1.183	2.09*	2.045*	1.247	1.106	1.392
Mk/BK	0.945	0.14	2.163*	1.103	1.057	0.097	2.225*	1.039
Price/CF	0.643	0.036	23.02*	0.845	0.642	0.036	25.606*	0.84
P/E	0.454	3.770*	0.813	0.825	0.454	3.77*	0.813	0.825

* < .01 level of significance

** < 0.05

*** < 0.10

1 Yr Return - One year shareholder return (adjusted by 4-digit GICS groups)

CFROI - Cash Flow Return on Investment

EBITDAM - EBITDA Margin

ROAA - Return on Average Assets

ROAEQ - Return on Average Equity

The Industry-Adjusted means, adjusted for outliers, show that Quickscore is not related to any performance measure, whereas Insider Holdings and Institutional Holdings are significantly related to nine (9) different performance measures, combined. Both variables are significant at the 5% level with NPM (Net Profit Margin).

While the ANOVA results show Quickscore is related only to Altman's Z Score with an F-statistic of 2.405, once outliers are controlled by winsorization, Quickscore does not appear to be related to any of the performance measures. Insider holdings and institutional holdings,

however, are significantly related to five (5) and six (6) performance measures, respectively. Specifically, the insider holdings measure is related to the one-year return, Tobin's Q, Return on Average Assets, Sales Growth, and the P/E ratio. The institutional holdings measure is related to Free Cash Flow/Sales, Return on Average Assets, Return on Investment, Sales Growth, Market/Book, and Price/Cash Flow. Combined, these two indicators of corporate governance are related to nine (9) of the fourteen (14) performance measures, whereas the QuickScore is related to only one.

Table II presents the results of the multivariate regressions with board independence, insider holdings, institutional holdings, and QuickScores as explanatory variables for firm performance. First, regarding the results with no control for outliers, the QuickScore measure plays a significant role in determining the one-year returns and Tobin's Q with the industry-adjusted performance measures, whereas insider holdings and institutional holdings significantly help in determining the one-year return and the Cash Flow Return on Investment (CFROI). On the right side of Table II, are the results using a control for outliers (i.e., winsorized data). Once again, the QuickScore is only significant in determining the one-year return. However, insider holdings and institutional holdings are each significant in determining three different industry-adjusted measures: One-Year Return, CFROI, and the 1-year Sales Growth. It appears that insider holdings and institutional holdings are better predictors of firm performance, outperforming the QuickScore measure. Table III includes results of a separate regression, with QuickScore by itself (with total assets as a control variable). For the QuickScore measure there is no significant relationship to any of the firm performance measures. However Table III shows that both insider holdings and institutional holdings (without QuickScore) are significant in predicting five (5) performance measures, one-year return, Tobin's Q, CFROI, EBITDAM, and 1-year Sales Growth.

The results of the additional regression analyses to examine if any of the governance proxies are related to an aggregation of performance measures are found in Table IV. The F-ratios in Table IV indicate that neither the ISS QuickScore nor insider holdings are related to the least squares aggregation of performance measures. However, in the case of board independence and institutional holdings, the F-test does allow rejection of the null hypothesis of no relationship. Moreover, the relationship between institutional holdings and the individual performance measures is of the expected sign in all cases but one.

V. Conclusions

It appears that two publicly available governance measures do as well or better than the proprietary QuickScore measure in predicting firm performance. The QuickScore, based on 181 variables, may not be the best guide for investors in their investment choices. The lack of evidence of a relationship between QuickScore and financial measures could possibly result due to its expression in deciles (Brownstein et. Al., 2013). There is evidence in the literature on the possible positive effects of insider holdings and institutional holdings. In particular, the insider holdings may serve as an incentive for management to make value-maximizing decisions, and institutional holdings serve as a monitor, "exiting" when bad management decisions are made. This study confirms not only the important roles of insider and institutional holdings, but also that the QuickScore may not be the best guide for investors.

TABLE II
Multivariate Regressions
With Insider Holdings, Institutional Holdings, and QuickScores as Explanatory Variables

Performance Measure	Industry-Adjusted Firm Performance Measures (Total Assets is not industry-adjusted)				Industry-Adjusted Firm Performance Measures Winsorized to Control for Data Outliers				
	One Year Return	Q	CF ROI	EBIT DAM	One Year Return	Q	CFROI	EBIT DAM	1 Yr Sales Growth
R2	3.4	3.7	5.5	2.1	3.9	3.8	6.6	2.1	2.2
AR2	2.4	2.8	4.5	1.1	3	2.8	5.6	1.1	1.3
F	3.484*	3.8	5.86	2.147*	4.12	3.87	7.126	2.147*	2.317
	*	478	6*	**	3*	4*	*	**	***
Constant	-0.075	0.477	-2.33	-	0.438	-0.049	-0.349	0.5	-0.316
t-Ratio	1.152	1.457	8.268*	-	2.034**	0.21	2.769*	2.019*	1.693***
Insider Holdings	0.382	0.984	1.156	-14.563	1.31	0.664	0.675	-1.103	0.772
t-Ratio	2.953*	1.526	2.062**	2.24	3.069*	1.442	2.690*	2.24	2.083**
Institutional	0.125	0.248	0.859	-7.283	644	0.177	0.492	-0.551	0.441
t-ratio	2.383**	0.697	2.791*	2.042	2.744*	0.694	3.578*	2.042	2.164**
QuickScore	-0.092	-0.12	0.007	-0.042	-0.31	-0.008	0.005	-0.003	-0.016
t-ratio	1.827*	5.13*	0.342	0.184	2.055**	0.644	0.587	0.184	1.23
Total Assets	0.045	-4.353	-2.854	0.987	0.323	-3.154	-0.956	0.074	-0.344

t-ratio	0.165	3.2*	2.418**	2.31288	0.359	3.245*	1.812***	0.071	0.441
Performance Measure	One Year Return	Q	CFR OI	EBITD AM	1 Yr Sales Growth	One Year Return	Q	CFR OI	EBITD AM
R2	2.6	3.7	5.4	2.1	1.7	0.5	3.1	3.1	0.2
AR2	1.8	3	4.7	1.3	1	0	2.6	2.7	0
F	3.238**	5.08*	7.819*	2.87**	2.358***	1.031	6.298*	6.617*	0.51
Constant	-115	0.424	-2.299	29.68	-1.029	0.071	0.684	-6.13	23.68
t-Ratio	1.863**	1.374***	8.639*	9.623*	0.255	2.355**	4.62*	12.543*	15.874*
Insider Holdings	0.35	0.942	1.183	-14.714	14.517				
t-Ratio	2.723*	1.477***	2.135**	2.291**	2.085**				
Institutional Holdings	0.163	0.234	0.865	-7.634	7.66				
t-ratio	2.290**	0.661	2.828*	1.077**	1.649**				
QuickScore						-0.006	-	0.014	-0.128
t-ratio						1.378***	0.2561	0.721	0.557
Total Assets	0.119	-4.276	-2.909	1.187	-8.236	-0.163	-	-	9.731
t-ratio	0.44	3.178*	2.494*	0.089	-0.465	0.62	4.623.537*	3.8653.402*	0.741

Note: Total Assets is not industry-adjusted.

Table III
Governance Indicators Regressed on Performance Measures
Industry Adjusted & Winsorized

	Board Ind.	Insider Holdings	Institution	Quick Score	Board Ind.	Insider Holdings	Institution	Quick Score
AR ²	0.044	0.00	0.06	0.013	0.044	0.027	0.052	0.001
F	4.674*	0.766	2.514*	1.025	4.671*	3.209*	5.350*	1.061
Constant (t-ratio)	0.768* (59.226)	0.040* (6.274)	0.805* (79.413)	5.386* (32.812)	0.465* (67.76)	0.042* (8.092)	0.790* (81.26)	5.369* (36.88)
1 Yr Return (t-ratio)	-0.032* (2.180)	0.006 (0.927)	0.300* (2.657)	-0.223 (1.200)	-.031* (2.330)	0.014** (2.259)	.026** (2.244)	-0.233 (1.364)
Tobin's Q (t-ratio)	-0.021 (1.062)	0.007 (0.806)	0.015 (0.924)	0.009 (0.037)	-.032* (2.542)	0.004 (0.744)	0.011 (0.541)	0.090 (0.522)
CFROI (t-ratio)	0.011 (0.377)	0.019 (1.457)	0.063* (2.805)	0.559 (1.529)	0.003 (1.33)	.020*** (1.894)	0.073* (3.792)	0.339 (1.183)
EBITDA M (t-ratio)	-0.004 (0.167)	-0.003 (0.347)	-.039** (2.329)	0.011 (0.042)	0.004 (0.318)	-.011** (2.090)	.006** (1.657)	-0.300 (0.203)
NPM (t-ratio)	0.046 (1.347)	-0.004 (0.750)	0.049** (1.846)	0.212 (0.494)				
ROAA (t-ratio)	-0.132* (2.731)	0.066 (0.729)	0.037 (0.978)	0.112 (0.184)				
ROI (t-ratio)	0.083* (2.089)	-0.019 (0.881)	0.106* (3.415)	-0.727 (1.453)				
Sales Growth (t-ratio)	-0.013 (0.700)	0.000 (0.026)	-0.001 (0.037)	0.046 (0.739)	.032* (2.052)	0.005 (0.748)	0.012 (0.913)	-0.143 (0.718)
Mk/BK (t-ratio)	-0.060 (0.875)	-0.005 (0.160)	0.101** (1.885)	0.284 (0.329)				
Price/CF (t-ratio)	0.076** (1.851)	-0.006 (0.294)	-0.011 (0.330)	-0.765 (1.480)				

Two-tailed tests: * < .01 level of significance ** < 0.05 *** < 0.10

In Table III linear regression is used to check the effects of multi-collinearity among performance measures. All performance measures are included in the regression but Free Cash Flows per Sales, Return on Equity, Altman's Z score, and the Price Earnings Ratio are not reported as they were never significant. While Quick score is not related to the performance measures taken together Institutional holdings is related. Moreover, with only one exception the significant relationships between Institutional Holdings and the performance measures are of the expected sign.

References

- Admati, A. R., and P. Pfleiderer (2009) "The Wall Street Walk and Shareholder Activism: Exit as a Form of Voice," *Review of Financial Studies*, 22, 2645-2685.
- Berle, A., and G. Means (1932, 1968) *The Modern Corporation and Private Property*, New York, Harcourt, Brace & World.
- Bhagat, S., and B. Bolton (2008) "Corporate Governance and Firm Performance," *Journal of Corporate Finance*, 14, 257-273.
- Bhattacharya, P., and M. Graham (2009) "On Institutional Ownership and Firm Performance: A Disaggregated View," *Journal of Multinational Financial Management* 19, No. 5, 370-394.
- Brownstein, A., D. Katz, T. Norwitz., and S. Ongun (2013) "ISS Quickscores: Back to the Future," *The Harvard Law School Law Forum on Corporate Governance and Financial Regulation*, Feb. 13.
- Cho, M. (1998) "Ownership Structure, Investment, and the Corporate Value: An Empirical Analysis," *Journal of Financial Economics* 47, No.1, 103-121.
- Dahya, J., and J. McConnell (2005) "Outside Directors and Corporate Board Decisions," *Journal of Corporate Finance*, 1-2.
- Duggal, R., and J. Millar (1999) "Institutional Ownership and Firm Performance: The Case of Bidder Returns," *Journal of Corporate Finance* 5, Issue 2, 103-117.
- Edmans, A. (2013) "Blockholders and Corporate Governance," Finance Working Paper No. 385; <http://ssrn.com/abstract=2285781>
- Edmans, A., and G. Manso (2011) "Governance Through Trading and Intervention: A Theory of Multiple Blockholders," *Review of Financial Studies* 24, 2395-2428.
- Holderness, C (2009) "The Myth of Diffuse Ownership in the United States," *Review of Financial Studies* 22, No. 4, 1377-1408.
- Jensen, M. (1993) "The Modern Industrial Revolution, Exit, and the Failure of Internal Control Systems," *Journal of Finance* 48, 831-880.
- Jensen, M., and W. Meckling (1976) "Theory of the Firm: Managerial Behavior, Agency and Ownership Structure," *Journal of Financial Economics* 3, No. 4, 305-360.
- Lee, S., and L. Carlson (2007) "The Changing Board of Directors: Board Independence in S & P 500 Firms," *Journal of Organizational Culture, Communications and Conflict* 11, No. 1, 31-41.
- Lee, S., (2013) "Repealing Classified Boards: What is the Motivation?" *Journal of Finance Issues* 11, No.2, <http://jofi.aof-mbaa.org/2013-vol11-issue2>
- Leech, D. and J. Leahy (1991) "Ownership Structure, Control Type Classifications and the Performance of Large British Companies," *Journal of Economics* 101, 1418-1437.
- Lipton, M., and J. Lorsch (1992) "A Modest Proposal for Improved Corporate Governance," *Business Lawyer* 48, 59-77.
- Monks, R., and N. Minow (1995) *Corporate Governance*, Basil Blackwell, Cambridge.
- Morck, R., A. Shleifer, and R. Vishny (1988) "Management Ownership and Market Valuation: An Empirical Analysis," *Journal of Financial Economics* 20, 293-315.
- Shleifer, A. and R. Vishny (1997) "A Survey of Corporate Governance," *Journal of Finance* 52, 737-783.
- Shleifer, A. and R. Vishny. (1986) "Large Shareholders and Corporate Control," *Journal of Political Economy* 94, 461-488.

