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CONTENTS

LETTER FROM THE EDITORS

Welcome to the *Academy of Accounting and Financial Studies Journal.* The editorial content of this journal is under the control of the Allied Academies, Inc., a non profit association of scholars whose purpose is to encourage and support the advancement and exchange of knowledge, understanding and teaching throughout the world. The mission of the *AAFSJ* is to publish theoretical and empirical research which can advance the literatures of accountancy and finance.

Dr. Michael Grayson, Jackson State University, is the Accountancy Editor and Dr. Denise Woodbury, Southern Utah University, is the Finance Editor. Their joint mission is to make the *AAFSJ* better known and more widely read.

As has been the case with the previous issues of the *AAFSJ*, the articles contained in this volume have been double blind refereed. The acceptance rate for manuscripts in this issue, 25%, conforms to our editorial policies.

The Editors work to foster a supportive, mentoring effort on the part of the referees which will result in encouraging and supporting writers. They will continue to welcome different viewpoints because in differences we find learning; in differences we develop understanding; in differences we gain knowledge and in differences we develop the discipline into a more comprehensive, less esoteric, and dynamic metier.

Information about the Allied Academies, the *AAFSJ*, and our other journals is published on our web site. In addition, we keep the web site updated with the latest activities of the organization. Please visit our site and know that we welcome hearing from you at any time.

Michael Grayson, Jackson State University

Denise Woodbury, Southern Utah University

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THE LINK BETWEEN COMMODITY PRICES AND COMMODITY-LINKED-EQUITY VALUES DURING A GEOPOLITICAL EVENT

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ABSTRACT

This paper investigates the link between commodity (gold and oil) prices and the returns and risk reactions of commodity linked-equity during a geopolitical event. In the short run, while the returns of gold and oil commodities increase by 8.01% and 4.27% respectively at the first trading day after 9/11 event, the gold equities realize negative returns, and oil equities stayed relatively unaffected. This shows a broken link between the returns of underlying commodities and the equities of commodity producing firms during a geopolitical risk event. In addition, we found that the 9/11 event increase systematic risk levels in both gold and oil industries.

INTRODUCTION

Alternative investments provide active portfolio managers an opportunity to reduce the standard deviations of their traditional bond-stock portfolios. Among the alternative investments, gold and oil commodities are special since they have low betas and correlations with the rest of the economy. Therefore, it is tempting for any portfolio manager to include gold and oil investments in their portfolios. However, a cautionary approach might be needed since gold and oil investments are highly sensitive to geopolitical risks. Lately, the geopolitical risk component of market risk might be on the rise due to increasing terrorism activities around the world. Therefore, active portfolio managers can reduce the negative effects of geopolitical risk on the value of their portfolios during heightened geopolitical risk periods/events by rebalancing their portfolios away from geopolitical risk sensitive industries.

Diversifying traditional bond-stock portfolios through alternative investments is not a new phenomenon. For example, Healey and Hardy (1997) documents the institutional investors' increasing appetite towards alternative investments including gold and oil stocks. In addition, Akey (2005) claims that active management in commodities may provide investors with an opportunity to earn returns superior to those of passive commodity indexes. Akey also points out to the increasing interest in commodities by the investors at a point that now we might consider commodities as an asset class itself. Campbell (2005) sees structured products referenced to commodities, especially oil and gold, as viable investment alternatives to increase diversification. Furthermore, Solnik (2000) outlines three direct ways to invest into commodities as through; (i) futures contracts, (ii) bonds indexed on some commodity price, and (iii) stocks of companies producing commodity.

Our paper focuses the third way as outlined by Solnik; investing into the stocks of gold and oil companies that produce gold and oil commodities. The link between gold and oil prices and the stocks of gold and oil producing firms is expected to be positively correlated. However, investing in commodities directly through futures contracts versus through commodity-linked equities are not the same. This link between commodity prices and the value of commodity linked-equity is severed by the dynamics of production process where other factors might affect commodity producing firm value. El-Sharif et al. (2005) investigates the link of crude oil prices and oil producing firm equities and finds a significant positive relationship and concludes that the volatility of crude oil prices being reflected into stock value of oil firms. In contrast, Simmons (2005) argues that the correlation of equity-linked security returns and the returns from the underlying commodity prices are not too high to make an investment in equity-linked securities. Simmons sees investing in commodities directly through futures contracts as a better way of investing.

Gold Commodity and Gold Stocks

Blose (1996) sees investing in gold as hedging against inflation, political risk, and currency exchange risk. There is no clear consensus on the effect of gold price over the value of gold producing (mining) firm stocks. According to Blose, the unstable dividends, political risks, currency exchange risks, and business risk related to gold mining technology might reduce the influence of gold prices on the returns of gold mining firm stocks. Jaffe (1989) argues that gold stocks might be a better investment than gold itself since the returns of gold stocks mirror the return on gold. Furthermore, Hillier et al. (2006) find that all precious metals including gold provide diversification benefits. They analyze the period from 1976 to 2004 and find that precious metals have hedging capability particularly during the periods of abnormal stock market volatility.

Furthermore, Solnik (2001) explains that Europeans and others have suffered from revolutions, invasions, and periods of hyperinflation and therefore there is a high degree of motivation to invest into gold as a protection during social, political, and economic crises. McDonald and Solnik (1977) find a negative correlation of -0.4 for the returns of S&P 500 stocks and gold during the period of 1948 and 1975. They conclude that gold allows investors to diversify against the kinds of risks that affect all stock markets simultaneously.

In terms of its financial effects, geopolitical risk is similar to the traditional wars and political turmoil and therefore might have simultaneous affects on all stock markets. In McDonald and Solnik's spirit, we investigate the short and long term effects of the 9/11 on gold and oil stocks since this geopolitical event is a shock to all world stock markets and simultaneous.

Oil Commodity and Oil Stocks

Because of its strategic importance, oil has emerged as another important commodity. The probability that the distribution channels of oil in the world might be disrupted by the geopolitical tensions and conflicts greatly affecting oil prices. Therefore, hedging against oil price fluctuations require an understanding of geopolitical risk and oil prices as well as the link between the oil prices and the equity values of energy companies.

In general, Oil industry provides a unique opportunity for portfolio managers to achieve further diversification in their portfolio due the defensive nature of these securities in financial markets. The underlying fundamentals driving the oil industry are not the same, and therefore in tandem with the rest of the economy. Furthermore, dissimilarities among the operating firms in the oil industry are extensive due to the long chain of exploration, production, refining, distribution and marketing stages.

Rzepczynski et al. (2004) show that adding crude oil to a traditional stock-bond portfolio can improve the risk return profile and creates a more efficient portfolio than a commodity index. In addition, Sadorsky (1999) uses a vector autoregression to show that oil prices and oil price volatility both play important roles in affecting real stock returns.

Even though oil are positively related to overall profitability of the firms and the economy (see Table 5), for small firms specializing in the downstream (refining, marketing and distribution), higher oil prices might reduce the retail demand for oil products, and thus lower the profitability. Therefore, the oil price sensitivity of a firm depends on how much the firm can cover the entire chain of oil activities (operations). In the same token, low crude oil price could reduce the profits of small firms at the exploration and production (E&P) stage. Therefore, the more is the coverage; the better is the reduction in risk exposure. The E&P firms operating only in the upstream or the firms operating only in the downstream (refining, marketing and distribution) are considered riskier than the operations of integrated oil firms, which combine both upstream and downstream activities. The hedging due to the integration of activities (operations) is due to the offsetting effects of crude oil prices on the upstream and downstream operations. The higher oil prices might benefit the E&P activities while it might hurt the downstream operations on the retail and consumption side.

Solnik (2000) explains that large, integrated oil firms are well-diversified in comparison to the smaller firms operating in the upstream (E&P). Therefore, we should expect that the correlation between the oil prices and the equity value of the well-diversified, integrated oil firms might be relatively lower than that of smaller oil firms.

In addition, oil has strategic importance for the world economies, and any concern over the disruption of its supply roots creates uncertainty in financial markets. Especially, the geopolitical risk arising from terrorism might disrupt the supply roots of oil, and thus increase oil prices. Therefore, there is interest for active portfolio managers to understand how the geopolitical risk factors might affect commodity prices and commodity-linked equity values. This paper investigates the changes in the risk and return characteristics of commodity-linked equities for gold and oil firms during a geopolitical risk event.

The 9/11 Event and Geopolitical Risk

The events of September 11, 2001, horrified the world and raised major concerns about the future economic well-being of the world economy. The intensity and the scale of political conflicts after the Second World War II might have been transformed to smaller scale regional conflicts and possibly heightened by terrorism activities. The terrorist attacks in the U.S. on September 11, 2001 might have affected world markets simultaneously and increased geopolitical risk. We hypothesize that the geopolitical sensitive commodities (gold and oil) and their producer's stocks are expected to be affected by the 9/11 event.

The IMF (2001) report puts the cost of the short-term effects of the September 11 attacks approximately at $21.4 billion, which is similar in magnitude to catastrophic natural disasters, such as earthquakes or hurricanes. However, Fisher (2001) emphasizes that the analogy of the 9/11 event to other natural disasters might be misleading since the 9/11 event may have long-lasting influences on investor and consumer confidence.

There is consensus on the short-term destabilizing effects of the 9/11 event on the U.S. and world capital markets given the serious damage inflicted on the U.S. economy. Naturally, one would expect the U.S. stock market to be affected negatively on the first trading days following the 9/11 event. Furthermore, there is lesser agreement on the potential long-term influence of the 9/11 event. The IMF (2001) report outlines the possible long-term consequences of the 9/11 event on international businesses as higher operating costs, higher level of inventories, higher risk premium, shift of resources from civilian labor force toward the military, and shift away from globalization. In contrast, some researchers (see, for example, Thornberg (2002) and Makinen (2002)) expect only short-lived effects in the aftermath of the 9/11 event due to the resilient structure of the U.S. and world stock markets. Even though there is agreement concerning the short-term incidence of the 9/11 attacks on domestic and international financial markets, its long-term incidence remains a matter of debate.

A number of studies have investigated the impact of the 9/11 event on the financial markets. Several have focused on the effects of the 9/11 event on the behavior of the U.S. financial markets. Carter and Simkins (2003) investigate the reaction of the U.S. airline stock prices to the 9/11 attack. Choudhry (2003) investigates the return and time-varying beta effects of the terrorist attacks for 20 U.S. firms. Straetmans *et al.* (2003) study the reactions of U.S. sectoral stock indices in the period of the 9/11 crisis. Liu *et al.* (2003) analyze the reaction of the REIT stocks to the 9/11 event. To gauge any suspicious market activity, Poteshman (2003) investigates the distribution of the U.S. airline option volumes in the time period leading up to September 11.

Another group of studies has focused on the impact of the 9/11 event on the world capital markets. Chen and Siems (2002) investigate the short-term global stock market reactions to several cataclysmic events. They find that 9/11 had a significant negative impact on the stock market returns around the world. Hon and Strauss (2003) analyze the contagion effects of the 9/11 event in the global markets. They report that there was an increase in correlation coefficients across global stock markets in the post-9/11 period. Using a survey methodology, Glaser and Weber (2003) examine the effects of 9/11 on the expected return and volatility forecasts of investors in Germany. Drakos (2003) analyzes the betas of six international airline stocks and finds that systematic risk increased during the post-9/11 period for these airline stocks. Richman *et al.* (2005) report that the long-term effects of 9/11 on the world capital markets have been largely transitory.

There are unanswered questions regarding the short- and long-term influences of the 9/11 event at the gold and oil firms. Did systematic risk increase in the aftermath of the 9/11 event and, if so, did it increase uniformly for gold and oil firms? In other words, was the risk profile of gold and oil firms worldwide were altered following the events of 9/11? What lessons can be learned about portfolio construction to reduce exposure to geopolitical risk?

Our paper records the gold and oil firm stock market reaction to the 9/11 event for a sample of 3 gold and 8 oil indexes/ETFs, 18 gold firms, 21 oil firms, and 23 oil service firms. Our finance-theoretic point of view is that of the capital asset pricing model, which is estimated through the application of seemingly unrelated regression to an exogenous event affecting all firms and industries simultaneously. In terms of short-term stock price reactions, there are negative returns for gold stocks and indexes. In addition, there are long-term systematic risk increases emanating from both the percentage changes in gold and oil prices after the 9/11 event. Systematic risk increases in gold prices were strikingly high in the case of gold stock indexes and stocks.

The remainder of the paper is constructed as follows. In Section 2, we present the data and estimation methodology. In section 3, we report our empirical findings and discuss the implications of the 9/11 event for the gold and oil stocks and stock indexes. We conclude in section 4 with a summary of our results.

DATA AND METHODOLOGY

Our sample consists of daily stock prices and indexes from gold and oil industries obtained for the period spanning June 13, 2001 to December 12, 2002, that is, 60 trading days before and 60 trading days after the 9/11 event. Data series are obtained from mainly Yahoo/finance database, but augmented further by gold prices from the Bank of England, West Texas Intermediate (WTI) crude oil prices from the Energy Information Administration (EIA) of the U.S. Department of Energy, the world index, MSCI, from Morgan Stanley Capital International, and gold and oil indexes from American Stock Exchange, Chicago Board of Options Exchange, and Philadelphia Stock Exchange.

Our finance-theoretic viewpoint is that of the multi-beta capital asset pricing model (CAPM) and our estimation method is seemingly unrelated regression (SUR) analysis. The traditional event-study methods based on the Cumulative Abnormal Returns (CARs), advocated by Fama *et al.* (1969) and Brown and Warner (1985) are not appropriate when the event takes place at one point in time as it violates the fundamental assumption of independent and identical distribution of the stock return residuals. Our model takes the following form:

$$R_{1,t} = \alpha_1 + \beta_1 R_{M,t} + \delta_1[\Delta P/P]_t + \gamma_1 D_t + \lambda_1 H_t R_{M,t} + \Omega_1 H_t[\Delta P/P]_t + e_{1,t} \quad (1)$$
$$R_{2,t} = \alpha_2 + \beta_2 R_{M,t} + \delta_2[\Delta P/P]_t + \gamma_2 D_t + \lambda_2 H_t R_{M,t} + \Omega_2 H_t[\Delta P/P]_t + e_{2,t}$$
$$. \quad . \quad . \quad .$$
$$R_{N,t} = \alpha_N + \beta_N R_{M,t} + \delta_N[\Delta P/P]_t + \gamma_N D_t + \lambda_N H_t R_{M,t} + \Omega_N H_t[\Delta P/P]_t + e_{N,t}$$

where:

$R_{i,t}$	= the total return for firm or index/ETF i on day t
$R_{M,t}$	= the MSCI world index return on day t. The MSCI index is used as a proxy of the world market return in the estimation of beta.
$[\Delta P/P]_t$	= the percentage price change on day t. Percentage changes are either in gold or oil prices for the estimation of additional beta in a multi-beta CAPM framework.
D_t	= dummy variable taking a value of 1 on the event day and 0 otherwise, and
H_t	= dummy variable taking a value of 1 on the event day as well as on the days in the entire post-event period, and 0 otherwise.

There are N return-generating equations stacked up together to make up the system in (1). For example, the first equation in the system for the oil index (Dynamic Energy Exploration & Production Intellidex Index, see Table 1) represents the daily return for the index with the following 7 equations (2^{nd} through 7^{th}) representing returns for the remaining 7 oil indexes in the oil indexes group.

To provide intuition into the estimated system of equations, let us analyze the first system equation representing the return-generating mechanism for the oil index (Dynamic Energy Exploration & Production Intellidex Index) given by $R_{1,t} = \alpha_1 + \beta_1 R_{M,t} + \delta_1[\Delta P/P]_t + \gamma_1 D_t + \lambda_1 H_t R_{M,t} + \Omega_1 H_t[\Delta P/P]_t + e_{1,t}$. It consists of two parts: the control component given by $(\alpha_1 + \beta_1 R_{M,t} + \delta_1[\Delta P/P]_t)$ and the event component given by $(\gamma_1 D_t + \lambda_1 H_t R_{M,t} + \Omega_1 H_t[\Delta P/P]_t)$. The control part is the typical CAPM augmented by the percentage changes in oil prices in line with Equation 2 below. The coefficient β_1 is the beta for the oil index (Dynamic Energy Exploration & Production Intellidex Index), which is a metric of its systematic risk level. Solnik (2000) provides a theoretical framework for obtaining β for gold as the following:

$$R = \alpha + \beta \frac{dG}{G} \qquad (2)$$

Where R is the gold stock return, α is intercept, β is gold stock beta, and $\frac{dG}{G}$ is the percentage change in gold stock prices. We incorporated the above model into our estimations by using $[\Delta P / P]_t$ as percentage changes in gold prices when the return equation is for gold indexes and firms. Additionally, we used as $[\Delta P / P]_t$ percentage changes in oil prices when the return equation was about oil indexes, oil firms, and oil service firms. Therefore, the above equation 1 has two factors with two betas, Beta 1, β_i, representing the world market risk, and Beta 2, δ_i, representing the fluctuations in gold and oil prices. The total beta can be obtained by adding two betas; β_i and δ_i. Faff and Chan (1998) also suggests that the inclusion of $[\Delta P / P]_t$ would provide a better fit for the returns of gold stocks.

The event component $(\gamma_1 D_t + \lambda_1 H_t R_{M,t} + \Omega_1 H_t [\Delta P / P]_t)$ includes the two separate dummies D_t and H_t, as defined above. A statistically significant estimate for the event parameter γ_i implies that the 9/11-event has short-run, return-related transfer of information to the industry index i. Even though it is difficult to put a specific value on human loss and property damage immediately after the 9/11 event, the horrific nature of this event is similar to a natural disaster and the return coefficients of industry indexes in the economy are hypothesized to be negative, $\gamma_i < 0$. However, if investors attempt to reduce the impact of geopolitical risk on their portfolio returns, money and portfolio managers may avoid certain industries with excessive exposure to such risk and invest in less vulnerable industries that appear to be good protectors for portfolio returns against terrorism risk. Consequently, the short-term return reaction of firms and industry indexes to the terrorist attacks may vary dependent upon the vulnerability of those industries to geopolitical risk.

The purpose of the dummy variable H_t in the event component is to convert the $R_{M,t}$ series into a subseries, $H_t R_{M,t}$, which takes 0 values on the event day, and becomes the market index return values, $R_{M,t}$, for the rest of the days. In other words, both $R_{M,t}$ and $H_t R_{M,t}$, have identical values on and after the event day. However, the two series are distinct enough over the 120-day period so that there is no multicollinearity problem. Systematic risk is broken down into two factors in our analysis; one representing world index, $R_{M,t}$, and the other representing percentage changes in gold or oil prices,$[\Delta P / P]_t$. A statistically significant coefficient estimate for λ_i indicates that the 9/11 has a long-term systematic risk effect on firm stock or industry index i, capturing a structural break in systematic risk for the world market (Beta 1) following the event. By the same token, a statistically significant coefficient estimate for indicates that the 9/11 has a long-term systematic risk effect (in the form of gold or oil price fluctuations) on firm stock or industry index i, capturing a structural break in systematic risk emanating from fluctuations of gold or oil prices (Beta 2) following the event. If the 9/11 event adversely impacted the expectations of investors and consumers about the fundamentals of firm or industry i, then a positive coefficient for λ_i or Ω_i are expected suggesting an abrupt increase in systematic risks in the post-9/11 beta estimate for the gold and oil index/ETF/stocks representing increase for gold or oil index/ETF/stock i.

In sum, while the first event parameter γ_i captures the short-term effect of the 9/11 event on industry i, the long-term influence of 9/11 is embedded in the coefficients of λ_i and Ω_i which account for changes in total systematic risk, as captured by the Beta (Beta 1 + Beta 2), subsequent to the event date.

EMPIRICAL RESULTS

Tables 1 to 4 below provide a summary of the gold and oil indexes/ETFs/stocks used in the equation system (1). More specifically, Table 1 provides the specifications of gold and oil indexes and ETFs. Moreover, Tables 2-4 provide the information about total assets and the number of full-time (FT) employees for the gold and oil firms.

Table 1: Gold and Oil Indexes/ETFs Included in the Study

INDICES/ETFs	Ticker Symbol	INDEX/ETF SPECIFICATIONSa
GOLD INDEXES		
1. CBOE GOLD INDEX	GOX	The CBOE Gold Index is an equal-dollar weighted index composed of 10 companies involved primarily in gold mining and production.
2. AMEX GOLD BUGS INDEX	HUI	The Amex Gold BUGS (Basket of Unhedged Gold Stocks) Index (HUI) is a modified equal dollar weighted index of companies involved in gold mining.
3. PHLX GOLD AND SILVER SECTOR INDEX	XAU	The PHLX Gold&Silver SectorSM (XAUSM) is a capitalization-weighted index composed of 16 companies involved in the gold and silver mining industry.
ENERGY AND OIL INDEXES/ETFs		
4. DYNAMIC ENERGY EXPLORATION & PRODUCTION INTELLIDEX INDEX	DWE	The Dynamic Energy Exploration & Production Intellidex Index (DWE) is a modified equal dollar weighted Index designed to identify stocks within the energy exploration and energy production industry that have capital appreciation potential using a proprietary stock selection and portfolio construction methodology.
5. DYNAMIC OIL SERVICES INTELLIDEX INDEX	DWO	The Dynamic Oil Services Intellidex Index (DWO) is a modified equal dollar weighted Index designed to identify stocks within the oil services industry that have capital appreciation potential using a proprietary stock selection and portfolio construction methodology.
6. DEUTSCHE BANK ENERGY INDEX	DXE	The Deutsche Bank Energy Index (DXE), formerly known as The NatWest Energy Index, is an equal-dollar weighted index based on shares of widely held companies involved in producing and providing oil and natural gas.
7. ENERGY SELECT SECTOR INDEX	IXE	The Energy Select Sector Index (IXE) is a modified market capitalization-based index intended to track the movements of companies that are components of the S&P 500 and are involved in

Table 1: Gold and Oil Indexes/ETFs Included in the Study		
INDICES/ETFs	Ticker Symbol	INDEX/ETF SPECIFICATIONSa
		the development or production of energy products.
8. ISHARES DOW JONES US ENERGY - ETF	IYE	The investment seeks investment results that correspond generally to the price and yield performance, before fees and expenses, of the Dow Jones U.S. Oil & Gas index. Category: Specialty-Natural Res, Fund Family: Ishares Trust, Net Assets: 913.76M, Legal Type: Unit Investment Trust
9. OIL SERVICES HOLDRS - ETF	OIH	The investment seeks to diversify your investments in the oil service industry through a single, exchange-listed instrument representing your undivided beneficial ownership of the underlying securities. The investment holds shares of common stock issued by specified companies that, when initially selected, were involved in the oil service industry.
10. ENERGY SELECT SECTOR SPDR - ETF	XLE	The Energy Select Sector Index includes companies from the following industries: oil, gas, energy equipment & services. Category: Specialty-Natural Res, Fund Family:Select Sector Spdr Trust, Net Assets: 4.53B, Legal Type: Unit Investment Trust
11. AMEX OIL INDEX	XOI	The Amex Oil Index (XOI) is a price-weighted index designed to measure the performance of the oil industry through changes in the prices of a cross section of widely-held corporations involved in the exploration, production, and development of petroleum.

Notes:
The specifications of indexes and ETFs can be obtained from the Philadelphia Stock Exchange website at http://www.phlx.com/products/xau.html, Chicago Board Options Exchange website at http://www.cboe.com/Products/indexopts/gox_spec.aspx, Yahoo/finance website at http://finance.yahoo.com, and American Stock Exchange (AMEX) website at http://amex.com.

Table 2: Gold Firms Included in the CBOE PowerPacks Gold Index (POU) and in the Study			
GOLD FIRMS AND HEADQUARTER LOCATION	Ticker Symbol	Total Assets ($000)	Number of FT Employees
1. BARRICK GOLD CORP – CAN	ABX	6862000	7400
2. AGNICO-EAGLE MINES - CAN	AEM	976069	789
3. ANGLOGOLD LTD – SOUTH AFRICA (SA)	AU	9113000	63993
4. BEMA GOLD CORP - CAN	BGO	627431	1938
5. CIA DE MINAS BUENAVEN- SA - PERU	BVN	1247841	1984
6. CAMBIOR INC - CAN	CBJ	576618	2700
7. COEUR D'ALENE MINES - US	CDE	594816	1206
8. GOLD FIELDS LTD – SOUTH AFRICA (SA)	GFI	3592900	N/A
9. GOLDPORT INC - CAN	GG	3803591	N/A

Table 2: Gold Firms Included in the CBOE PowerPacks Gold Index (POU) and in the Study			
GOLD FIRMS AND HEADQUARTER LOCATION	Ticker Symbol	Total Assets ($000)	Number of FT Employees
10. GLAMIS GOLD LTD - US	GLG	721200	1352
11. HARMONY GOLD MINING COMP- SA	HMY	4556677	47067
12. KINROSS GOLD CORP. - CAN	KGC	1705200	4000
13. LIHIR GOLD LTD – PAPUA NEW GUINEA	LIHRY	903820	N/A
14. MERIDIAN GOLD INC. - US	MDG	403900	282
15. NEWMONT MINING CORP- US	NEM	13992000	15000
16. PAN AMERICAN SILVER CORP - CAN	PAAS	356787	2050
17. APEX SIL.MIN. LTD–CAYMAN ISLANDS	SIL	780511	400
18. SILVER STANDARD RES. INC - CAN	SSRI	188149	16

Notes:
Source: Chicago Board Options Exchange at http://www.cboe.com/Products/IndexOpts/pou_spec.aspx. The CBOE PowerPacks Gold Index (POU) is a narrow-based, modified capitalization-weighted index composed of twenty-five securities, all of which are either U.S.-listed common stocks, American Depository Receipts (ADRs), New York Registered Shares (NYSs) or NYSE Global Shares® (NGSs). The component U.S.-listed common stocks and ADRs are traded on the New York Stock Exchange (NYSE), NASDAQ Stock Market, or the American Stock Exchange. The component NYSs and NGSs are only traded on the NYSE. The index is composed of the highest capitalization international and domestic companies that focus on the mining of gold, silver and/or other precious metals and which are actively traded in the U.S. Six firms with ticker symbols of AUY, EGO, GOLD, GRS, IAG, and SLW are excluded from the study due to unlimited number of available data for the span of the study.
Total assets and number of FT employees figures are obtained from Yahoo/finance website and the information was dated based on the 31-Dec-05 or 31-Dec-04 balance sheets and current profile information.

Table 3: Oil Firms Included in the CBOE PowerPacks Oil Index (POY) and in the Study			
OIL FIRMS AND HEADQUARTER LOCATION	Ticker Symbol	Total Assets ($000)	Number of FT Employees
1. APACHE CORP - US	APA	19,271,796	2,806
2. ANADARKO PETROLEUM - US	APC	22,588,000	3,300
3. BRITISH PETROLEUM PLC - UK	BP	198,027,000	96,200
4. BG GROUP PLC - UK	BRG	19,154,225	5,363
5. CNOOC LTD – HONG KONG	CEO	11,355,374	2,696
6. CANADIAN NATURAL RES. LTD - CAN	CNQ	19,021,860	2,580
7. CONOCOPHILLIPS - US	COP	106,999,000	35,600
8. CHEVRONTEXACO CORP - US	CVX	125,833,000	59,000
9. DEVON ENERGY CORP - US	DVN	30,273,000	4,075
10. IMPERIAL OIL LTD - CANADA	IMO	13,369,356	5,100

Table 3: Oil Firms Included in the CBOE PowerPacks Oil Index (POY) and in the Study			
OIL FIRMS AND HEADQUARTER LOCATION	Ticker Symbol	Total Assets ($000)	Number of FT Employees
11. MARATHON OIL CORPORATION - US	MRO	28,498,000	27,756
12. OCCIDENTAL PETROLEUM CORP - US	OXY	26,108,000	8,017
13. PETROLEO BRASILEIRO SA -BRA	PBR	63,082,000	N/A
14. PETRO-CANADA - CAN	PCZ	18,211,908	4,816
15. PETROCHINA CO LTD - CHINA	PTR	71,011,000	439,220
16. ROYAL DUTCH SHELL PLC - NE	RDS-B	N/A	109,000
17. REPSOL YPF SA - SPAIN	REP	52,649,467	35,909
18. SASOL LTD – SOUTH AFRICA	SSL	12,072,243	30,004
19. SUNCOR ENERGY INC - CAN	SU	13,197,756	5,152
20. TOTAL - FRANCE	TOT	161,011,48	112,877
21. EXXON MOBIL CORP - US	XOM	208,335,000	106,100

Notes:
Source: Chicago Board Options Exchange website: http://www.cboe.com/Products/indexopts/poy_spec.aspx. The CBOE PowerPacks Oil Index (POY) is a narrow-based, modified capitalization-weighted index composed of twenty-five securities, all of which are either U.S.-listed common stocks, American Depository Receipts (ADRs), New York Registered Shares (NYSs) or NYSE Global Shares® (NGSs). The component U.S.-listed common stocks and ADRs are traded on the New York Stock Exchange (NYSE), NASDAQ Stock Market, or the American Stock Exchange. The component NYSs and NGSs are only traded on the NYSE. The index is composed of the highest capitalization international and domestic companies within the oil sector involved in exploration and production of petroleum products that are actively traded in the U.S. One firm with a ticker symbol of ECA is excluded from the study due to unlimited number of available data for the span of the study.
Total assets and number of FT employees figures are obtained from Yahoo/finance website and the information was dated based on the 31-Dec-05 or 31-Dec-04 balance sheets and current profile information.

Table 4: Oil Services Firms The CBOE PowerPacks Oil Services Index (PVO) and in the Study			
OIL SERVICES FIRMS AND HEADQUARTER LOCATION	Ticker Symbol	Total Assets ($000)	Number of FT Employees
1. ACERGY SA - UK	ACGY	1384500	4442
2. BAKER HUGHES INC - US	BHI	7807400	29100
3. BJ SERVICES CO. -US	BJS	3396498	13600
4. CAMERON INTER CORP. - US	CAM	3098562	12200
5. SEACOR HOLDINGS INC. - US	CKH	2885141	5035
6. GLOBAL INDUSTRIES LTD. -US	GLBL	857314	3024
7. GRANT PRIDECO INC - US	GRP	1540284	4506
8. HALLIBURTON CO - US	HAL	9327000	106000

Table 4: Oil Services Firms The CBOE PowerPacks Oil Services Index (PVO) and in the Study			
OIL SERVICES FIRMS AND HEADQUARTER LOCATION	Ticker Symbol	Total Assets ($000)	Number of FT Employees
9. HANOVER COMPRESSOR CO - US	HC	2862996	6250
10. HELIX ENERGY SOLUTIONS - US	HELX	1660864	1800
11. HYDRIL CO. - US	HYDL	450562	1700
12. LONE STAR TECHNOLOGY - US	LSS	979300	2699
13. MAVERICK TUBE CORP. - US	MVK	1239290	4649
14. NATIONAL OILWELL VARCO - US	NOV	2998200	18979
15. OCEANEERING INTER - US	OII	989568	5500
16. OIL STATES INTERNATIONAL - US	OIS	1342872	5236
17. SMITH INTERNATIONAL INC. - US	SII	4059914	14697
18. SCHLUMBERGER LIMITED - US	SLB	18077492	60000
19. SUPERIOR ENERGY SERVICES - US	SPN	1097250	3200
20.TIDEWATER INC. - US	TDW	2364540	7500
21. TETRA TECHNOLOGIES INC - US	TTI	726850	1668
22. VERITAS DGC INC - US	VTS	966598	2794
23. WEATHERFORD INTER INC. - US	WFT	8580304	25100

Notes:
Source: Chicago Board Options Exchange website: http://www.cboe.com/Products/indexopts/pvo_spec.aspx. The CBOE PowerPacks Oil Services Index (PVO) is a narrow-based, modified capitalization-weighted index composed of twenty-five securities, all of which are either U.S.-listed common stocks, American Depository Receipts (ADRs), New York Registered Shares (NYSs) or New York Stock Exchange (NYSE) Global Shares® (NGSs). The component U.S.-listed common stocks and ADRs are traded on the NYSE, NASDAQ Stock Market, or the American Stock Exchange. The component NYSs and NGSs are only traded on the NYSE. The index is composed of the highest capitalization international and domestic companies focused on oil and gas services that are actively traded in the U.S. One firm with ticker symbol of DRC is excluded from the study due to unlimited number of available data for the span of the study. Total assets and number of FT employees figures are obtained from Yahoo/finance website and the information was dated based on the 31-Dec-05 or 31-Dec-04 balance sheets and profile sections.

Table 5 below is a correlation matrix showing the relationships among the returns of world, gold, and oil indexes for our estimation period. We can make the following conclusions based on the estimates of the correlation coefficients from Table 5.

(i) Percentage changes in gold and oil prices are both negatively correlated with the returns of the MSCI World index. The correlation coefficient is -0.44 between the changes in gold prices and the MSCI World index. In addition, the correlation coefficient is -0.12 between changes in oil prices and the MSCI World index. Therefore, both gold and oil commodities are promising to be a good hedging to a traditional bond-stock portfolio. This result is consistent with the earlier findings in the literature [see Solnik (2000)].

Table 5
Correlation Coefficients Among Returns of Commodity Prices (Gold and Oil) and the Returns of World, Gold, and Oil Indexes

				GOLD INDEXES				OIL INDEXES						
	GOLDP	OILP	MSCI	GOX	HUI	XAU	DWE	DWO	DXE	IXE	IYE	OIH	XLE	XOI
GOLDP	1.00													
OILP	0.14	1.00												
MSCI	-0.44	-0.12	1.00											
GOX	0.26	0.12	-0.31	1.00										
HUI	0.32	0.18	-0.39	0.93	1.00									
XAU	0.23	0.13	-0.28	0.92	0.89	1.00								
DWE	-0.04	0.46	0.25	-0.08	-0.08	-0.06	1.00							
DWO	-0.04	0.37	0.21	-0.05	-0.05	-0.03	0.86	1.00						
DXE	-0.08	0.48	0.29	-0.04	-0.03	-0.02	0.95	0.89	1.00					
IXE	-0.11	0.44	0.39	-0.13	-0.12	-0.09	0.94	0.84	0.97	1.00				
IYE	-0.07	0.44	0.29	-0.10	-0.10	-0.08	0.94	0.87	0.96	0.96	1.00			
OIH	-0.06	0.38	0.16	-0.01	0.00	0.01	0.84	0.96	0.89	0.83	0.87	1.00		
XLE	-0.04	0.42	0.34	-0.12	-0.10	-0.09	0.92	0.82	0.94	0.97	0.94	0.81	1.00	
XOI	-0.06	0.50	0.34	-0.07	-0.06	-0.04	0.93	0.78	0.95	0.97	0.94	0.77	0.94	1.00

Notes: GOLDP = returns of Gold price, OILP = Returns of Oil price, and MSCI= Returns of Morgan Stanley Capital International World Index. Light-shaded area refers to the correlation coefficients of gold index returns with others, dark-shaded area refers to the correlation coefficients of oil index returns with others, and darkest-shaded area refers to the correlation coefficient between gold and oil indexes. The daily returns were estimated for a period that spans from June 13, 2000 to December 12, 2000.

(ii) The correlation coefficients between percentage changes in gold prices and the returns of gold indexes are rather low ranging from 0.23 to 0.32. In addition, the correlation between percentage changes in oil prices and the returns of oil indexes are slightly higher ranging from 0.37 to 0.50. Both of these results suggest that the link between the commodity (gold and oil) prices and the commodity-linked equities are not high. These findings are consistent with Simons (2005) suggestion that "…if you want to trade commodities, trade commodities. Proxy instruments such as the IGE (Natural Resources iShares, AMEX ETF) reflect dynamics other that the prices of the underlying physical commodities."

(iii) The correlation coefficients between the percentage changes in oil prices and the returns of gold indexes are generally low but positive. And, the percentage changes in gold prices are negatively correlated with the returns of oil indexes/ETFs. Furthermore, the correlation of the returns from gold indexes and oil indexes/ETFs are very low and mostly negatively correlated.

All these findings confirm that investment in both gold or oil commodities could provide additional diversification for traditional bond-stock portfolios.

Table 6 below presents the results of the SUR system regressions that run for the sub-groups for gold indexes, oil indexes/ETFs, gold firms, oil firms, and oil service firms. In each of the SUR estimations, we imposed a general system restriction to make both event and control variable parameters to be equal across equations within the system for the sub-groups. Additionally, we presented F-tests next to our estimation results to confirm whether our system restrictions were valid hypotheses.

Table 6: Event Study Parameter Estimates for Political and Economic Events with System Restrictions at the Event Date: 17 September 2001

INDEXES/FIRMS (#)	EVENT PARAMETERS			F-TESTS		
	$_i$(RETURN) (t-stat)	l_i (RISK 1) (t-stat)	W_i (RISK 2) (t-stat)	F-test for g_i [P-Value]	F-test for l_i [P-Value]	F-test for W_i [P-Value]
GOLD INDEXES (3)	-0.0699** (-2.12)	0.1070 (0.31)	1.3631** (2.30)	1.96 (0.1423)	1.16 (0.3137)	0.44 (0.6415)
GOLD FIRMS (18)	0.0015 (0.07)	0.0547 (0.24)	1.1948*** (3.04)	2.34*** (0.0015)	0.95 (0.5152)	0.87 (0.6092)
OIL INDEXES (7)	0.0048 (0.39)	0.4008* (1.96)	0.1024 (1.58)	2.84*** (0.0041)	1.35 (0.2171)	0.63 (0.7493)
OIL FIRMS (21)	0.0127 (1.48)	0.1707 (1.18)	0.1251*** (2.73)	4.58*** (0.0001)	1.52* (0.0663)	0.69 (0.8443)
OIL SERV FIRMS (23)	-0.0152 (-0.93)	0.6735** (2.44)	0.1030 (1.18)	1.84** (0.0102)	1.14 (0.2913)	1.50* (0.0637)
CONTROL VARIABLES			F tests			
	b_i (BETA 1) (t-stat)	d_i (BETA 2) (t-stat)	F-test for b_i [P-Value]	F-test for d_i [P-Value]		
GOLD INDEXES (3)	-0.4054 (-1.48)	-0.3079 (-0.66)	3.00* (0.0508)	0.47 (0.6231)		
GOLD FIRMS (18)	-0.1680 (-0.93)	-0.2946 (-0.95)	2.03*** (0.0074)	0.48 (0.9616)		
OIL INDEXES (7)	0.4335** (2.61)	0.1620*** (3.00)	2.44** (0.0129)	0.95 (0.4753)		
OIL FIRMS (21)	0.3593*** (3.06)	0.0529 (1.39)	1.11 (0.3319)	1.05 (0.3958)		
OIL SERV FIRMS (23)	0.0790 (0.35)	0.1567** (2.15)	0.96 (0.5157)	0.54 (0.9615)		

Notes:
*Estimated coefficient is significant at the 10 percent level (two-tailed test), ** At the 5 percent level (two-tailed test)
*** At the 1 percent level (two-tailed test).

In order to be confident about the parameter estimates in Table 6, first we should find that t estimates are statistically significant. Second, we should fail to reject F-hypothesis implying the equality of coefficients within the SUR estimation system.

According to Table 6, the returns of gold indexes realize a negative return of 6.90 percent at the event date. However, there was a positive 8.01 percent increase in the price of gold after the 9/11. This is not an inconsistency and it is consistent with the findings from Table 5 indicating low correlations between the percentage changes of gold prices and the returns of gold equities. Solnik (2000) describes the link between gold prices and commodity-linked equities as far from being perfect.

Furthermore, there is a statistically significant increase in the systematic risk factor emanating from the percentage changes in gold prices according to Table 6 results. Both of these results may hold true since, we could not reject the equality of coefficients by the F-tests. A similar finding for all the gold firms run together indicate that there were long-term systematic risk increases emanating from the percentage changes of gold price. While the systematic risk increase (thereby increase in beta) for gold indexes altogether were 1.36 and for all gold firms together were 1.19. These are strikingly high systematic risk jumps and the investors would require higher required returns from gold stocks after a geopolitical risk event - the 9/11 terrorist attack.

Despite having a 4.6 percent positive increase in oil prices at the 9/11 date, we do not observe positive returns in the case of commodity-linked oil equities. However, both the oil equities in the SUR system provide a similar conclusion that systematic risk has been increased emanating from the percentage changes in oil prices after the 9/11 event. However, the world market systematic risk component has not been affected by the event. On the other hand, the findings for the oil service firms show slightly different results. Oil service firms have statistically significant long-term systematic risk increase in world market risk.

The second part of Table 6 shows the coefficient estimations for the control variables. Both world market index and percentage changes in gold prices are not statistically significant to explain the returns of gold indexes and firms. In contrast, both the returns of world market index and percentage changes in oil prices are statistically significant explanatory variables for oil indexes. The returns of world index explain the returns of oil firms. Additionally, there is evidence that the returns of oil service firms are explained better by the percentage changes in oil prices.

Table 7 below provides individual index/ETF reactions of event parameters to the 9/11 event. Again, 2 out of 3 gold indexes have negative return reactions at the event date similar to our finding in Table 6. Additionally, all three indexes have statistically significant long-term systematic risk increase in the form of percentage changes in gold prices. These results further enhance our Table 6 results. In the similar fashion, 6 out of 8 oil indexes/ETFs have long-term systematic risk increases in percentage changes in oil prices. Again, this supports our findings from Table 6.

Tables 8-10 below provide more detailed analysis for the SUR system at the firm level for gold, oil, and oil services sub-groups. These results are provided to show support for our earlier findings.

Table 7: Gold and Oil Sector Indexes/ETFs				
INDEXES OR ETFs	Ticker	g_i(RETURN) (t-stat)	l_i (RISK 1) (t-stat)	W_i (RISK 2) (t-stat)
GOLD INDEXES				
1. CBOE GOLD INDEX	GOX	-0.0658* (-1.83)	0.3306 (0.88)	1.5922** (2.46)
2. AMEX GOLD BUGS INDEX	HUI	-0.0417 (-1.15)	0.2759 (0.73)	1.5701** (2.40)
3. PHLX GOLD AND SILVER SECTOR INDEX	XAU	-0.0730** (-2.21)	0.0958 (0.28)	1.3477** (2.27)
ENERGY AND OIL INDEXES/ETFs				
4. DYNAMIC ENERGY EXPLORATION & PRODUCTION INTELLIDEX INDEX	DWE	-0.0048 (-0.27)	0.3694 (1.25)	0.1737* (1.86)
5. DYNAMIC OIL SERVICES INTELLIDEX INDEX	DWO	-0.0028 (-0.10)	0.7778 (1.63)	0.1806 (1.19)
6. DEUTSCHE BANK ENERGY INDEX	DXE	-0.0121 (-0.74)	0.5081* (1.85)	0.1733** (1.99)
7. ENERGY SELECT SECTOR INDEX	IXE	-0.0033 (-0.22)	0.3682 (1.44)	0.1714** (2.11)
8. ISHARES DOW JONES US ENERGY - ETF	IYE	-0.0137 (-0.79)	0.2624 (0.90)	0.1933** (2.09)
9. OIL SERVICES HOLDRS - ETF	OIH	-0.0323 (-0.96)	0.7141 (1.26)	0.2703 (1.50)
10. ENERGY SELECT SECTOR SPDR - ETF	XLE	0.0062 (0.38)	0.4185 (1.51)	0.2073** (2.36)
11. AMEX OIL INDEX	XOI	-0.0028 (-0.20)	0.2883 (1.20)	0.1631** (2.14)

Notes: *Estimated coefficient is significant at the 10 percent level (two-tailed test),
** At the 5 percent level (two-tailed test),
*** At the 1 percent level (two-tailed test).

Table 8: The Event Parameter Estimations for Gold firms				
FIRMS	Ticker	g_i(RETURN) (t-stat)	l_i (RISK 1) (t-stat)	W_i (RISK 2) (t-stat)
1. BARRICK GOLD CORP – CAN	ABX	-0.0558 (-1.42)	0.2320 (0.57)	0.6931 (0.98)
2. AGNICO-EAGLE MINES - CAN	AEM	-0.0651 (-1.27)	0.2815 (0.53)	1.8194* (1.98)
3. ANGLOGOLD – SOUTH AFRICA (SA)	AU	-0.0300 (-0.75)	0.2298 (0.56)	1.2762* (1.78)

FIRMS	Ticker	g_i(RETURN) (t-stat)	l_i (RISK 1) (t-stat)	W_i (RISK 2) (t-stat)
Table 8: The Event Parameter Estimations for Gold firms				
4. BEMA GOLD CORP - CAN	BGO	-0.0078 (-0.08)	-0.1041 (-0.11)	1.7223 (1.01)
5. CIA DE MINAS BUENAVEN- SA - PERU	BVN	0.0533 (1.79)	0.0883 (0.29)	1.2050** (2.25)
6. CAMBIOR INC - CAN	CBJ	-0.1465 (-1.22)	-2.2223* (-1.78)	1.1392 (0.53)
7. COEUR D'ALENE MINES - US	CDE	0.1276 (1.45)	1.2479 (1.36)	-0.6767 (-0.43)
8. GOLD FIELDS – SOUTH AFRICA (SA)	GFI	-0.0191 (-0.32)	0.2490 (0.40)	1.1517 (1.06)
9. GOLDPORT INC - CAN	GG	-0.0525 (-1.23)	0.4121 (0.93)	1.5979** (2.08)
10. GLAMIS GOLD LTD - US	GLG	0.0530 (0.92)	0.5566 (0.93)	1.5856 (1.53)
11. HARMONY GOLD MINING COMP- SA	HMY	0.0379 (0.64)	0.4692 (0.77)	1.0408 (0.98)
12. KINROSS GOLD CORP. - CAN	KGC	-0.0091 (-0.12)	1.4784* (1.91)	2.5875* (1.93)
13. LIHIR GOLD – PAPUA NEW GUINEA	LIHRY	-0.1480*** (-2.62)	0.1201 (0.58)	2.8006*** (2.75)
14. MERIDIAN GOLD INC. - US	MDG	-0.0839 (-1.40)	0.8611 (1.38)	1.9932* (1.84)
15. NEWMONT MINING CORP- US	NEM	-0.0370 (-0.72)	0.0441 (0.08)	1.2382 (1.33)
16. PAN AMERICAN SILVER CORP - CAN	PAAS	-0.0122 (-0.22)	0.0338 (0.06)	1.6163 (1.65)
17. APEX SIL.MIN.–CAYMAN ISLANDS	SIL	0.0092 (0.16)	0.0084 (0.01)	0.1463 (0.14)
18. SILVER STANDARD RES. INC - CAN	SSRI	0.1256 (2.07)	0.1003 (0.16)	0.9786 (0.90)

Notes: *Estimated coefficient is significant at the 10 percent level (two-tailed test),
** At the 5 percent level (two-tailed test),
*** At the 1 percent level (two-tailed test).

Table 9: The Event Parameter Estimations for Oil firms				
FIRMS	Ticker	g_i(RETURN) (t-stat)	l_i (RISK 1) (t-stat)	W_i (RISK 2) (t-stat)
1. APACHE CORP - US	APA	-0.0174 (-0.64)	0.4763 (1.05)	0.2150 (1.49)
2. ANADARKO PETROLEUM - US	APC	-0.0280 (-1.10)	0.6765 (1.57)	0.2008 (1.47)
3. BRITISH PETROLEUM PLC - UK	BP	0.0288 (1.65)	0.5403* (1.83)	0.1525 (1.63)
4. BG GROUP PLC - UK	BRG	0.0114 (0.45)	0.1954 (0.45)	0.1621 (1.19)
5. CNOOC LTD – HONG KONG	CEO	0.0987*** (4.55)	0.1090 (0.30)	0.2866** (2.47)
6. CANADIAN NATURAL RES. - CAN	CNQ	0.0158 (0.74)	0.1680 (0.46)	0.1389 (1.21)
7. CONOCOPHILLIPS - US	COP	0.0150 (0.72)	0.1597 (0.46)	0.0695 (0.63)
8. CHEVRONTEXACO CORP - US	CVX	-0.0116 (-0.72)	-0.0988 (-0.36)	0.1463* (1.70)
9. DEVON ENERGY CORP - US	DVN	-0.0056 (-0.18)	0.3387 (0.65)	0.3729** (2.27)
10. IMPERIAL OIL LTD - CANADA	IMO	-0.0042 (-0.25)	0.0390 (0.14)	0.2237** (2.52)
11. MARATHON OIL CORP - US	MRO	-0.0138 (-0.75)	0.7552** (2.44)	0.1273 (1.30)
12. OCCIDENTAL PETROLEUM - US	OXY	-0.0108 (-0.58)	0.7023** (2.23)	0.2229** (2.24)
13. PETROLEO BRASILEIRO SA -BRA	PBR	0.0044 (0.17)	0.4345 (0.98)	0.2163 (1.54)
14. PETRO-CANADA - CAN	PCZ	0.0515*** (2.81)	0.3652 (1.18)	0.0696 (0.71)
15. PETROCHINA CO LTD - CHI	PTR	0.0098 (0.50)	-0.1660 (-0.51)	0.0816 (0.78)
16. ROYAL DUTCH SHELL PLC - NE	RDS-B	0.0274 (1.49)	0.8157*** (2.63)	0.1339 (1.36)
17. REPSOL YPF SA - SPA	REP	0.0507** (2.51)	0.4613 (1.36)	0.0758 (1.09)
18. SASOL LTD – SOUTH AFRICA	SSL	0.0132 (0.59)	0.4784 (1.27)	0.1300 (1.08)
19. SUNCOR ENERGY INC - CAN	SU	0.0475** (2.58)	0.1270 (0.41)	0.1419 (1.44)

Table 9: The Event Parameter Estimations for Oil firms

FIRMS	Ticker	g_i(RETURN) (t-stat)	l_i (RISK 1) (t-stat)	W_i (RISK 2) (t-stat)
20. TOTAL - FRA	TOT	-0.0014 (-0.08)	0.3801 (1.38)	0.1563* (1.78)
21. EXXON MOBIL CORP - US	XOM	0.0073 (0.50)	0.2997 (1.22)	0.1331* (1.72)

Notes
: *Estimated coefficient is significant at the 10 percent level (two-tailed test),
** At the 5 percent level (two-tailed test),
*** At the 1 percent level (two-tailed test).

Table 10: The Event Parameter Estimations for Oil Services firms

FIRMS	Ticker	g_i(RETURN) (t-stat)	l_i (RISK 1) (t-stat)	W_i (RISK 2) (t-stat)
1. ACERGY SA - UK	ACGY	0.0022 (0.05)	1.6553** (2.28)	0.3036 (1.32)
2. BAKER HUGHES INC - US	BHI	0.0043 (0.14)	0.8051 (1.53)	0.4191** (2.51)
3. BJ SERVICES CO. -US	BJS	-0.0064 (-0.13)	0.8826 (1.06)	0.3542 (1.34)
4. CAMERON INT. CORP. - US	CAM	-0.0315 (-0.87)	0.6991 (1.14)	0.3977** (2.04)
5. SEACOR HOLDINGS INC. - US	CKH	-0.0244 (-0.87)	0.2304 (0.49)	-0.0068 (-0.05)
6. GLOBAL INDUSTRIES LTD. -US	GLBL	0.0090 (0.21)	0.0706 (0.10)	0.4745** (2.10)
7. GRANT PRIDECO INC - US	GRP	0.0128 (0.23)	0.8725 (0.93)	0.5873* (1.98)
8. HALLIBURTON CO - US	HAL	-0.0467 (-0.76)	0.3171 (0.31)	0.1195 (0.36)
9. HANOVER COMPRESSOR CO - US	HC	0.0426 (1.14)	1.2893** (2.05)	0.3546* (1.78)
10. HELIX ENERGY SOLUTIONS - US	HELX	0.0529 (1.32)	1.0849 (1.60)	0.2062 (0.96)
11. HYDRIL CO. - US	HYDL	0.0091 (0.17)	0.3271 (0.37)	0.1559 (0.56)
12. LONE STAR TECH INC - US	LSS	0.0509 (0.87)	1.2956 (1.31)	0.3517 (1.12)
13. MAVERICK TUBE CORP. - US	MVK	-0.0436 (-1.06)	0.1816 (0.26)	0.1105 (0.50)

Table 10: The Event Parameter Estimations for Oil Services firms				
FIRMS	Ticker	g_i(RETURN) (t-stat)	l_i (RISK 1) (t-stat)	W_i (RISK 2) (t-stat)
14. NATIONAL OILWELL VARCO -US	NOV	-0.0063 (-0.14)	0.7236 (0.97)	0.3311 (1.41)
15. OCEANEERING INTER INC - US	OII	0.0123 (0.33)	1.6332** (2.62)	0.1240 (0.63)
16. OIL STATES INT. INC - US	OIS	0.0646 (1.44)	1.5599** (2.07)	0.2299 (0.96)
17. SMITH INTERNATIONAL INC. - US	SII	-0.0484 (-1.26)	0.6805 (1.05)	0.2795 (1.36)
18. SCHLUMBERGER LIMITED - US	SLB	-0.0394 (-1.37)	0.0988 (0.20)	0.2065 (1.34)
19. SUPERIOR ENERGY SERV - US	SPN	-0.0056 (-0.13)	1.6931** (2.40)	-0.0812 (-0.36)
20.TIDEWATER INC. - US	TDW	-0.0281 (-0.89)	0.5343 (1.01)	0.1289 (0.77)
21. TETRA TECHNOLOGIES INC - US	TTI	0.0304 (0.64)	1.4811* (1.84)	0.1323 (0.52)
22. VERITAS DGC INC - US	VTS	0.0299 (0.48)	1.2039 (1.15)	0.1083 (0.33)
23. WEATHERFORD INT. INC. - US	WFT	-0.0086 (-0.21)	0.6395 (0.93)	0.3249 (1.49)
Notes: *Estimated coefficient is significant at the 10 percent level (two-tailed test), ** At the 5 percent level (two-tailed test), *** At the 1 percent level (two-tailed test).				

Finally, Tables 11-14 below provide the estimates of control variables at the event date to further scrutinize the previous results. In Table 11, both CBOE and AMEX gold indexes have negative Beta 1 coefficients, -0.6136 and -0.7095 respectively, calculated as the coefficients of the world market return. These beta estimates are statistically significant at 5 percent level. Our finding is a similar to the results from earlier studies that the negative betas are expected from the returns of the world market indexes. In addition, the relatively low Beta 1s and Beta 2s for oil indexes in Table 11 show that oil stocks could be also used as effective portfolio diversifiers.

Table 11: Gold and Oil Sector Indexes/ETFs and Parameter Estimates of Control Variables in the Market Modela				
INDEXES/ETFs	Ticker	Intercept	bi (BETA1)	di (BETA2)
GOLD INDEXES				
1. CBOE GOLD INDEX	GOX	-0.0004	-0.6136**	-0.4496

Table 11: Gold and Oil Sector Indexes/ETFs and Parameter Estimates of Control Variables in the Market Modela

INDEXES/ETFs	Ticker	Intercept	bi (BETA1)	di (BETA2)
2. AMEX GOLD BUGS INDEX	HUI	-0.0009	-0.7095**	-0.5144
3. PHLX GOLD AND SILVER SECTOR INDEX	XAU	-0.0004	-0.3777	-0.2892
ENERGY AND OIL INDEXES/ETFs				
4. DYNAMIC ENERGY EXPLORATION & PRODUCTION INTELLIDEX INDEX	DWE	-0.0003	0.2659	0.1686**
5. DYNAMIC OIL SERVICES INTELLIDEX INDEX	DWO	-0.0014	0.1219	0.2339*
6. DEUTSCHE BANK ENERGY INDEX	DXE	-0.0003	0.1954	0.1783**
7. ENERGY SELECT SECTOR INDEX	IXE	-0.0008	0.4623**	0.1489**
8. ISHARES DOW JONES US ENERGY - ETF	IYE	-0.0002	0.3808	0.1425*
9. OIL SERVICES HOLDRS - ETF	OIH	-0.0012	0.0624	0.2376
10. ENERGY SELECT SECTOR SPDR - ETF	XLE	-0.0008	0.3997*	0.1167
11. AMEX OIL INDEX	XOI	0.0000	0.4109**	0.1673***

Notes:
The above coefficient estimates are obtained from a market model representing the control component of equation system, Ri,t =a +biRM,t + di[ΔP/P]t with contemporaneous MSCI world index, and the percentage changes in gold or crude oil prices. *Estimate coefficient is significant at the 10 percent level (two-tailed test), ** At the 5 percent level (two-tailed test), *** At the 1 percent leve (two-tailed test).

Table 12: Gold Firms and Parameter Estimates of Control Variables in the Market Modela

GOLD FIRMS	Ticker	Intercept	bi (BETA1)	di (BETA2)
1. BARRICK GOLD CORP – CAN	ABX	-0.0006	-0.5478*	0.2356
2. AGNICO-EAGLE MINES - CAN	AEM	0.0014	-0.8879**	-0.6185
3. ANGLOGOLD LTD – S. AFRICA (SA)	AU	0.0000	-0.1069	-0.2829
4. BEMA GOLD CORP - CAN	BGO	-0.0003	-1.5850**	-0.1500
5. CIA DE MINAS BUENAVENTU- PERU	BVN	0.0004	-0.1129	-0.4602
6. CAMBIOR INC - CAN	CBJ	0.0087	1.0565	-0.6472
7. COEUR D'ALENE MINES - US	CDE	-0.0088	-2.0764***	0.7435
8. GOLD FIELDS LTD – S. AFRICA (SA)	GFI	0.0007	-0.3793	0.0795
9. GOLDPORT INC - CAN	GG	0.0007	-0.4676	-0.6116
10. GLAMIS GOLD LTD - US	GLG	0.0013	-0.8946*	-0.1754
11. HARMONY GOLD MINING - SA	HMY	0.0001	-0.7796	-0.3514
12. KINROSS GOLD CORP. - CAN	KGC	-0.0045	-2.1180***	-0.5773
13. LIHIR GOLD – PAPUA NEW GUINEA	LIHRY	0.0036	-0.2719	0.1802
14. MERIDIAN GOLD INC. - US	MDG	0.0015	-1.2644**	-0.0025

Table 12: Gold Firms and Parameter Estimates of Control Variables in the Market Modela				
GOLD FIRMS	Ticker	Intercept	bi (BETA1)	di (BETA2)
15. NEWMONT MINING CORP - US	NEM	-0.0008	-0.4736	-0.3588
16. PAN AMERICAN SILVER CORP - CAN	PAAS	0.0001	-0.5728	-1.0692
17. APEX SILV MINES–C. ISLANDS	SIL	-0.0014	-0.4522	-0.1926
18. SILVER STANDARD RES. INC - CAN	SSRI	0.0007	-0.8610*	-0.9503

Notes
The above coefficient estimates are obtained from a market model representing the control component of equation system, Ri,t =ai +biRM,t + di[ΔP/P]t with contemporaneous MSCI world index, and the percentage changes in gold or crude oil prices. *Estimated coefficient is significant at the 10 percent level (two-tailed test), ** At the 5 percent level (two-tailed test), *** At the 1 percent level (two-tailed test).

Table 13: Oil Firms and Parameter Estimates of Control Variables in the Market Modela				
OIL FIRMS	Ticker	Intercept	bi (BETA 1)	di (BETA 2)
1. APACHE CORP - US	APA	0.0008	0.1594	0.3032**
2. ANADARKO PETROLEUM - US	APC	0.0006	-0.0270	0.2458**
3. BRITISH PETROLEUM PLC - UK	BP	-0.0005	0.4293*	0.1153
4. BG GROUP PLC - UK	BRG	0.0002	0.2759	0.0407
5. CNOOC LTD – HONG KONG	CEO	-0.0004	0.3806	-0.1364
6. CANADIAN NATURAL RES - CAN	CNQ	-0.0008	0.2559	0.2616***
7. CONOCOPHILLIPS - US	COP	-0.0003	0.0096	-0.0258
8. CHEVRONTEXACO CORP - US	CVX	0.0005	0.4496**	0.1339*
9. DEVON ENERGY CORP - US	DVN	-0.0018	0.2136	0.1636
10. IMPERIAL OIL LTD - CANADA	IMO	0.0013	0.0321	0.0901
11. MARATHON OIL CORP. - US	MRO	0.0003	-0.0010	0.2490***
12. OCCIDENTAL PETROLEUM - US	OXY	0.0001	0.0525	0.1839**
13. PETROLEO BRASILEIRO SA -BRA	PBR	-0.0003	0.4883	0.1968*
14. PETRO-CANADA - CAN	PCZ	-0.0008	0.0687	0.1680**
15. PETROCHINA CO LTD - CHI	PTR	-0.0007	0.5278*	0.0134
16. ROYAL DUTCH SHELL PLC - NE	RDS-B	-0.0012	0.5254**	0.1112
17. REPSOL YPF SA - SPAIN	REP	-0.0012	0.4915*	0.1284
18. SASOL LTD – SOUTH AFRICA	SSL	-0.0004	0.5358*	0.0394
19. SUNCOR ENERGY INC - CAN	SU	0.0015	0.2632	0.1693**
20. TOTAL - FRANCE	TOT	0.0005	0.5209**	0.1491**
21. EXXON MOBIL CORP - US	XOM	-0.0002	0.6011***	0.1102*

Notes:
The above coefficient estimates are obtained from a market model representing the control component of equation system, Ri,t =ai +biRM,t + di[ΔP/P]t with contemporaneous MSCI world index, and the percentage changes in gold or crude oil prices. *Estimated coefficient is significant at the 10 percent level (two-tailed test), ** At the 5 percent level (two-tailed test), *** At the 1 percent level (two-tailed test).

Table 14: Oil Service Firms and Parameter Estimates of Control Variables in the Market Modela

OIL SERVICE FIRMS	Ticker	Intercept	bi (BETA1)	di (BETA 2)
1. ACERGY SA - UK	ACGY	-0.0047	-0.1238	0.0044
2. BAKER HUGHES INC - US	BHI	0.0010	0.1972	0.1588
3. BJ SERVICES CO. -US	BJS	0.0010	0.1245	0.2908
4. CAMERON INTER CORP. - US	CAM	-0.0025	0.2544	0.2090
5. SEACOR HOLDINGS INC. - US	CKH	0.0003	0.4325	0.2244*
6. GLOBAL INDUSTRIES LTD. -US	GLBL	-0.0026	0.9212	0.2421
7. GRANT PRIDECO INC - US	GRP	-0.0035	0.2292	-0.0141
8. HALLIBURTON CO - US	HAL	-0.0063	0.3896	0.2283
9. HANOVER COMPRESSOR CO - US	HC	-0.0013	0.1251	0.0345
10. HELIX ENERGY SOLUTIONS - US	HELX	-0.0001	0.1066	0.1234
11. HYDRIL CO. - US	HYDL	-0.0012	0.8489	0.2836
12. LONE STAR TECHNOLOGY - US	LSS	-0.0051	0.4739	0.1584
13. MAVERICK TUBE CORP. - US	MVK	-0.0030	0.5511	0.1523
14. NATIONAL OILWELL VARCO-US	NOV	-0.0024	0.3593	0.2118
15. OCEANEERING INTER INC - US	OII	0.0001	-0.5276	0.3017*
16. OIL STATES INTER INC - US	OIS	-0.0013	-0.1381	0.2425
17. SMITH INTERNATIONAL INC. - US	SII	-0.0011	-0.0356	0.2534
18. SCHLUMBERGER LIMITED - US	SLB	0.0009	0.3130	0.2070
19. SUPERIOR ENERGY SERV. - US	SPN	-0.0024	-0.7075	0.2917
20.TIDEWATER INC. - US	TDW	-0.0015	0.0500	0.2388*
21. TETRA TECHNOLOGIES INC - US	TTI	-0.0006	-0.0082	0.3110
22. VERITAS DGC INC - US	VTS	-0.0037	0.0803	0.3705
23. WEATHERFORD INTER INC. - US	WFT	-0.0014	0.2641	0.2461

Notes:
The above coefficient estimates are obtained from a market model representing the control component of equation system, Ri,t =ai +biRM,t + di[ΔP/P]t with contemporaneous MSCI world index, and the percentage changes in gold or crude oil prices. *Estimated coefficient is significant at the 10 percent level (two-tailed test), ** At the 5 percent level (two-tailed test), *** At the 1 percent level (two-tailed test).

CONCLUSIONS

This paper investigates the returns and risk reactions of commodities and commodity linked-equity during a geopolitical event. There are contrasting results at the first trading day after 9/11 event: while the returns of gold and oil commodities increase by 8.01% and 4.27% respectively as we would expect, the gold equities realize negative returns, and oil equities stayed relatively unaffected. Furthermore, we found that the 9/11 event increase systematic risk levels in both gold and oil industries.

Solnik (2001) documents that gold has been investors' choice of commodity during the wars, political unrests, and other severe economic downturns throughout the history. This fact has not been altered during the 9/11 event. Investors still see commodities such as gold or oil as viable investment avenues. Despite the rush on gold commodity, the gold producing firm equities were not on high demand right after the 9/11 event. Similarly, investors were relatively indifferent to gold equities during the event period. The brief lesson to learn from this study for the investment practioners is to distinguish commodity investing from equity investing, and therefore invest into commodities during heightened geopolitical risk periods to realize hedging benefits. We suggest to asset managers working for mutual funds, pension plans, investment banking firms, and lately hedge funds to include geopolitical risk in the analysis of the gold- and oil-linked equity purchases. Investing into equities of commodity producing firms is not the same and may not hedge investors against geopolitically risky events.

According to our study, there is increasing risk aversion towards gold and oil commodities after the 9/11 event. This requires investors to demand higher required returns form the gold and oil producing firms. There is a lesson to be learned by theoreticians in the field that the intensity of risk and return reactions to a geopolitical event are not the same for all strategic commodities. Even though both gold and oil are considered as strategic commodities, gold and gold linked equity reactions to the 9/11 event has been much stronger in the short- and long-run than the reactions of oil and oil linked equities.

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THE USEFULNESS OF COST ALLOCATIONS: AN EXPERIMENTAL INVESTIGATION

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ABSTRACT

This paper reports the effects of service department cost allocation schemes on demands for service by divisional managers. Cost allocations have been suggested to be useful in specific managerial settings (Thomas 1980). Zimmerman (1979) suggested that if allocation methods that include the costs of externalities (e.g., delays, degraded service) were developed, they should encourage decisions that are more behaviorally congruent than decisions made with methods that do not incorporate externality costs.

The general experimental setting in this research consists of a decentralized firm with two manufacturing divisions and a centrally-run service department. The role of each division manager is to demand maintenance, knowing the specific benefits the maintenance will have on divisional profits, but only the allocation method used to charge for the cost of the service provided. Parameters of the experiment are set so as to discourage excessive demands by the managers.

Five allocation methods are used in this study along with a control group that makes the same decision (how much maintenance to demand) with no costs allocated to the division. To test various hypotheses, amounts of maintenance demanded are compared between methods and are compared to optimal levels for the firm and for the divisions.

MOTIVATION AND LITERATURE REVIEW

The usefulness of accounting cost allocations has been debated for many years. Arthur Thomas argued that financial cost allocations, which are typically allocations over time, are irrelevant (Thomas 1969, 1974). However, he discusses in other works (Thomas 1971, 1980) that cost allocations for managerial purposes, such as the allocation of joint and common costs and transfer pricing, might be useful in attaining goal congruence between managers' behavior and the objectives of the firm. He categorizes an allocation method as behaviorally congruent if it encourages managers to act in ways that are consistent with what central management wants (Thomas 1980: 11-12).

Research has shifted to the positive question of why cost allocations are used. Zimmerman (1979) is one of the earliest to identify situations where cost allocations could yield net positive benefits to the firm. The cases he uses to illustrate the usefulness of cost allocations are those where externalities arise from the use of a common resource or service. In particular he notes how not allocating any of the fixed cost of a WATS line can result in overuse of the service and can impose delay costs on those waiting to use the service. In another situation he considers a decentralized firm providing a common resource or service to its independent divisions. When there is a limited amount of the common service or resource available, as one division increases its usage of the resource, less is available to the other divisions. A reduction in available resources can impose costs on these other divisions by causing delays, by reducing the quality of the output in the divisions, or by causing the divisions to seek out other, more expensive alternatives. While these costs are hard to observe and difficult to quantify, they represent opportunity costs or externalities to the other divisions.

The implication of these examples is that the actual cost to the firm of providing common resources or services to the divisions is more than just the reported costs. There can exist opportunity costs, resulting from externalities imposed on one division by another when a limited resource is shared, that could significantly add to the cost of operating a service department. As explained by Zimmerman (1979: 515), "[T]he value of the firm is larger ... if each production manager takes account of the costs which he imposes on the other managers by consuming more of the fixed resource when choosing his mix of inputs. That is, instead of just looking at the reported costs of the factors, each manager should also consider all the costs he generates via delays, degradation and eventual expansion costs in the service departments."

A suggestion from Zimmerman (1979) is that cost allocations can be useful in such settings. By incorporating proxies for the costs of the externalities into the cost allocation methods, the division managers are forced to consider the impact of their consumption of the common resource or service on the other divisions. Such allocations can be useful in the sense that the managers may adjust their resource utilization when cost allocations include these opportunity costs. Their decisions may then result in a higher value for the firm than the value resulting when their decisions are based on cost allocations that do not incorporate the opportunity costs.

Several authors have explored theoretical solutions to some of the cost allocation issues using mathematical models and various assumptions. One of the issues relates to congestion costs or opportunity costs. Miller and Buckman (1987) find that allocating fixed costs can proxy for opportunity costs. They use queuing theory to model the service department as an M/M/s/s system in a continuous time, stochastic setting. This specific form of the stochastic process is necessary to obtain some of the crucial results. (Full descriptions of the various systems are beyond the scope of this paper, but are discussed in the cited references.) The cost allocation or transfer price is assumed to take the form of a fixed amount plus the variable costs associated with the service request. If the non-negative fixed amount is zero, the cost allocation is the variable cost; however, if the fixed amount is equal to an allocated portion of the fixed costs of service department, then the cost allocated to the user represents full cost (Miller and Buckman 1987: 628). One of the nice features of the setting chosen by Miller and Buckman is that the opportunity costs of satisfying a request for service will be random and will vary with the level of service usage in the department at the time of the request (Miller and Buckman 1987: 630). If the fixed cost C(s), the cost of capacity at service level s, is approximately linear, Miller and Buckman theoretically demonstrate that a full cost allocation method is a valid proxy for the average opportunity cost, which is also the optimal transfer price under the conditions of their setting.

Along similar lines, Balachandran and Srinidhi (1990) model the service center as an M/G/I system. With a well-behaved function for the cost of capacity and when short-run estimates of the system parameters equal the long-term planned estimates of the parameters, the allocation of fixed capacity costs equal opportunity costs, and this allocation again results in usage of the service department at the optimal level (Balachandran and Srinidhi 1990: 579). In another article, the same authors provide additional settings where this optimality is achieved (Balachandran and Srinidhi 1988). Several authors have looked at the incentive aspects of cost allocations. Young (1985), in particular, discusses allocations as a motivational tool to induce participants (the service department manager and service users) into achieving optimal overall firm profit.

The cost allocation issues related to congestion (opportunity costs) and incentives have been analyzed along with information aspects. Whang (1989) uses a game-theoretic model to analyze the effect of different allocation schemes on eliciting relevant information from users regarding their valuations of the service. In this model, users report anonymously their values of the service, the manager of the service department purchases capacity based on the reports, and prices (cost allocations) are set based on realized demands for the service. Whang (1989: 1269) shows that if allocations are set to marginal cost, users have the incentive to overstate demands, the capacity level chosen (purchased) will cause users to complain of too little service, but the service department manager will ignore the reports and the complaints, knowing of the likely over-stated demands. However, if a full-cost allocation method is used, users are induced to reveal their true valuations of the services, and this method also achieves ex post efficiency in allocating the service to the users (Whang 1989: 1271). This is considered a full-information efficient accounting rule, achieving optimal acquisition (of capacity) and allocation decisions (Whang 1989: 1269).

Another issue involving cost allocation is the inclusion of allocated costs when a cost-plus pricing scheme is used to price the final product or service of the firm. If revenues are used as a basis for cost allocation, then there seems to be a circular problem – costs are needed to determine revenues, but revenues are based on costs. Schneider (1987) shows that it is possible to determine cost-based product prices and cost allocations simultaneously which provide a unique profit maximizing solution. Pavia (1995) also identifies allocation methods which maximize the firm’s overall profit in a similar scenario. Examples are used to clarify the implications of such cost allocations on prices and demands in four settings.

In an extended piece, Drury (2000) provides a review of research on cost allocations and a history of chargeback systems for informational technology and computer services costs. An assessment of whether chargeback systems should be used is detailed, and the development of a framework for choosing chargeback systems and an evaluation of the systems’ effectiveness is provided. With the substantial fixed cost of capacity necessary for maintaining up-to-date computer technology, and the fact that the technology and its costs are changing rapidly, this area may provide additional considerations for the use of cost allocations.

While the above discussed research investigates theoretical solutions (under specific formulations of the problem), and examines the congestion (opportunity cost), incentive, and/or informational aspects of cost allocations, the current paper takes an experimental approach to examine the usefulness of cost allocations in the sense discussed above. The setting used is one where service department costs are allocated to the manufacturing divisions of a decentralized firm. Subjects, acting as division managers, determine the amount of maintenance to be provided to their divisions, knowing the effect the maintenance will have on their expected profits and the cost allocation method to be used in assigning the costs of the service department to the divisions. Five cost allocation methods are employed in this experiment with a between-subjects design. One of these five methods incorporates a type of opportunity cost. Also a control group, where no costs are allocated to the divisions, is used.

Several testable hypotheses are evident. First, the subjects' responses can be tested to see if use of a cost allocation method affects the amount of service demanded. Then the experiment allows testing of whether a cost allocation method incorporating costs of externalities is more useful (in terms of encouraging globally optimal service-usage decisions from division managers) than an allocation method that does not incorporate such costs. Other commonly used cost allocation methods also are examined for their usefulness. These and other research questions are written as formal hypotheses in a later section. The next section provides a description of the research setting and the allocation methods used in the experiment.

RESEARCH SETTING

While the examples in Zimmerman (1979) serve as a basis for this study, some details of Zimmerman's scenario are modified to eliminate some potential sources of confounding. First, an unlimited amount of the common resource is used in this study. This avoids a potential resource allocation problem - how the common resource is distributed among the divisions - that could arise if a limited amount of common resource were available and the divisions demand more than the amount available. A marginally-increasing cost function for the service department is used as one way of discouraging excessive demands for maintenance in this study. (In a study examining the effects of incentive pay schemes on managerial behavior, Waller and Bishop (1990) are able to allocate inputs to divisions based on the projected productivity ratios communicated to central management by the division managers. In their experiments, a division receives 80 (20) inputs if the communicated ratio is higher (lower) than that communicated by the other division. Both receive 50 inputs if the ratios are equal.)

A second problem arises when trying to define the opportunity costs or costs of externalities imposed on the users of the service. Determining these costs and a reasonable proxy for them is difficult in most situations. However, if a way to quantify the opportunity costs exists, the costs can be incorporated into an allocation method and explained in more concrete terms to the users. For this study, an ad hoc allocation method is defined which explicitly quantifies the cost of externalities in the form of higher average costs imposed when higher than optimal levels of service are demanded by a user.

The setting for this study is a decentralized firm with two manufacturing divisions and a centrally-run service department. A division's profit is based on the quantity and/or quality of the output from its manufacturing process. The condition of the machinery used in the manufacturing division is the critical factor. In the course of normal operations, the machinery experiences general deterioration, causing a decrease in the quantity/quality of output, and thus, a decrease in profit.

To offset the deterioration to some degree, each division manager can request that maintenance activities be performed on the machinery in their division by the service department. The maintenance improves the quantity/quality of the output, and thus, increases profit. However, the division is charged for the maintenance demanded based on a known cost allocation method. Profit for the division is determined by the profit from salable output minus the cost allocation from the service (maintenance) department.

This setting is incorporated into the experimental design as follows. Subjects take the role of division managers. At the beginning of the first operating period, the possible profit from manufactured output is represented by a 100-point range, called the initial range, which is set at 900 - 1000 points. Deterioration of the machinery causes a 150-point downward shift of the 100-point range. (The resulting range is called the deteriorated range.) The division manager then may request maintenance to offset the deterioration. Maintenance is supplied in "units" and, due to the nature of this service the increase in profit is smaller for each additional unit of maintenance provided in a given period. That is, the function relating increases in profit to units of maintenance exhibits decreasing marginal benefits.

The 100-point range shifts upward by an amount determined by the number of units of maintenance provided (this is called the final range). The actual profit from output for the period is determined by a random draw from the final range. This number is called the period results. Net profit is the period results minus the costs allocated (in points) for the units of maintenance provided, and is called performance points.

The final range of one operating period becomes the initial range for the next period, and the steps above are repeated: deterioration shifts the range downward by 150 points; the manager demands maintenance, which shifts the range upward; and the final results are determined. Performance points for the manager are accumulated for four operating periods and an average is taken. (Four operating periods constitutes a round.) The subject then is compensated (paid $2) if the average number of performance points is greater than or equal to a random draw from the range of average points that could possibly have been earned. The lower end point of the range of possible average points that can be earned is the lower end of the range of points if no maintenance is provided for four periods, divided by four. The upper end point is the upper end of the range of points if the amounts of maintenance that are optimal (given the allocation method) were provided during the four periods, divided by four. The range of possible average points differs among allocation methods. (Calculations of these ranges are available from the authors upon request. This method of compensating the subjects for participating in the experiment at the end of each round is equivalent to Berg, et al.'s (1986) method of inducing risk preferences. Use of a uniform distribution (random draw) from a range of possible values attempts to induce risk neutral behavior.) The subjects participate in a total of eight rounds (32 operating periods).

To provide empirical evidence on whether cost allocation methods do affect service demand levels, one group of subjects was used as a control group where service level decisions were made but no service department costs were allocated to the divisions. While this is not an allocation method per se, it is called method M1 for this study. If allocation methods affect the amounts of service demanded, the average demands for this control group should be significantly different from those of the other groups where service department costs are allocated to the divisions.

To investigate the ideas from Zimmerman (1979), an allocation method that incorporates opportunity costs must be explicitly defined. For this study, one such ad hoc method is defined relative to a commonly used allocation method. The allocation of actual costs at average cost per unit is used as method M2. (Note that the average cost per unit of maintenance will depend on the levels of service demanded by both divisions.) Given the marginally increasing cost function for the service department, if total demand for service exceeds the optimal amount, x^*+y^*, (determined from the firm's profit-maximization problem), both divisions are charged a unit cost that is higher than the optimal unit cost, CPU*. Thus if one division demands an excessive amount of maintenance while the other does not, driving the total demand above x^*+y^*, average cost per unit, CPU, will be greater than CPU*. This higher unit cost can be considered an opportunity cost that is imposed on other users by the division demanding excessive service. This higher unit cost is used to define the ad hoc cost allocation method, M3, which is described next.

If the total amount of service demanded is less than or equal to the optimal total amount of service, then method M3 allocates costs just as method M2. The average unit cost is not greater than CPU*. There are two cases when the total demand for service is greater than optimal: 1) when one division demands more than its optimal level, and 2) when both divisions each demand more than their optimal levels. In case (1), one division demands an amount less than or equal to its optimal amount, say x, and should not be penalized for the higher unit cost that results from the other division demanding so much of the service. The ad hoc method would allocate costs to the first division at CPU*, and the division demanding such large quantities of service would be charged the rest of the cost (total cost minus x times CPU*).

In case (2), both divisions' demands cause the unit cost to be above CPU* by demanding service above their divisions' optimal levels. The excess costs (costs above those at the optimal demand levels), total cost minus CPU* times x^*+y^*, are allocated to the divisions in proportion to their excess demands, $x-x^*$ and $y-y^*$. And each division is charged CPU* times their optimal demand levels to cover the costs of that demand.

If M3, which includes a type of opportunity cost, leads to decisions which are better from a firm-wide perspective, then the average service levels with method M3 will be significantly different from those made with method M2, and those with M3 should be closer to the optimal levels (the solution to the firm's profit-maximization problem).

Three other allocation methods are also employed. Use of a predetermined rate is common since it allows managers knowledge of the allocation rate or unit cost before the service is demanded. In this study, a predetermined rate approximately equal to the average unit cost at optimal demand levels is used as method M4.

Marginal cost, a well-cited value for the pricing of products and services, is used as method M5 in this study. Under this method, unit cost is equal to the marginal cost at the total level of service demanded by the two divisions. Note that this method allocates to the divisions more than the total actual costs incurred.

Finally, given the interest in and predominance of the game theory literature and its implications, a game theory-based allocation method is used as method M6. Shapley value allocations, described to the subjects in terms of average incremental costs, are used. Note that with only two divisions, Shapley value allocations are equivalent to average actual cost allocations - method M2.

THE EXPERIMENT

A between-subjects experimental design was used, where cost allocation method was the treatment variable. Each subject was randomly assigned to a treatment group (designated by allocation method), and thus, was exposed to only one allocation method. For the allocation methods that required the choices of both division managers in order to calculate the cost allocations (M2, M3, M5, and M6), subjects were randomly and anonymously paired for the experiment, remaining with the same partner for the duration of the experiment. Subjects were volunteers from an MBA program at a graduate business school, and signed up for one of several available sessions. Session sizes ranged from 1 to 10 subjects. Each session lasted for an hour to an hour and a half. The sessions were conducted over several weeks, and each was supervised by the one of the authors.

Each session was conducted with the same general format. The sequence of events was as follows: The subjects first read a set of written instructions, which included a description of the general setting for the experiment, the details of how the setting was implemented as a computerized exercise, a description of the allocation method used to charge the division for the maintenance demanded, and an explanation of how money could be earned. Once all subjects finished reading, the computerized part of the experiment started. This consisted of eight rounds of four operating periods each. The first round was conducted as a group - the supervisor verbally led the group through the first four operating periods. Various options and computer displays were explained (these are discussed below). Then the subjects completed the remaining seven rounds on their own. Finally each subject filled in a post-experiment questionnaire, which requested information regarding the subject's background, education, and perceptions about the experiment.

HYPOTHESES

Several hypotheses are under investigation in this study. First, given a control group where no costs are allocated to the divisions, the effect of the allocation methods on maintenance choice can be tested. Stated in null form,

> $H1_0$: *The allocation of service department costs does not affect the level of service demanded by the division managers.*

A comparison is made between the demand levels for each group (allocation methods M2, M3, M4, M5, and M6) and the demand levels when no costs are allocated (M1).

A major point of this investigation is to compare a method that incorporates opportunity costs with one that does not. This is done in several steps. First, the demand levels from method M2 are compared to those of method M3 to see if they are significantly different from each other. This hypothesis (in null form) is stated:

> $H2_0$: *A cost allocation method incorporating opportunity costs (M3) results in demand levels that are the same as the demand levels chosen when costs are allocated by a method not incorporating the opportunity costs (M2).*

Zimmerman (1979) suggested that a method such as M3 might lead to decisions that are better for the firm as a whole. To determine whether either method M2 or M3 results in choices of maintenance which are equal to the amounts optimal for the firm as whole, the following hypotheses are tested:

> $H3A_0$: *When costs are allocated to divisions by method M2, the choices of maintenance made by division managers are equal to the choices that are optimal for the firm as a whole.*

> $H3B_0$: *When costs are allocated to divisions by method M3, the choices of maintenance made by division managers are equal to the choices that are optimal for the firm as a whole.*

The optimal demand levels are needed to conduct the statistical tests of these hypotheses. The optimal levels are the solution to the firm's profit-maximization problem, which is discussed later.

Finally, a measure of which allocation method, M2 or M3, yields maintenance decisions that are closer to the optimal choices is calculated. Euclidean distance is used to see which method induces decisions that are closer to the optimal choices for the firm. The motivation for introducing method M3 into the research design would be supported if method M3 yields maintenance choices that are closer to the optimal choices than those under method M2.

The other allocation methods can also be compared to the optimal values for the firm:

$H3C_0$: When costs are allocated to divisions by method M1, the choices of maintenance made by division managers are equal to the choices that are optimal for the firm as a whole.

$H3D_0$: When costs are allocated to divisions by method M4, the choices of maintenance made by division managers are equal to the choices that are optimal for the firm as a whole.

$H3E_0$: When costs are allocated to divisions by method M5, the choices of maintenance made by division managers are equal to the choices that are optimal for the firm as a whole.

$H3F_0$: When costs are allocated to divisions by method M6, the choices of maintenance made by division managers are equal to the choices that are optimal for the firm as a whole.

If one of these null hypotheses cannot be rejected at a significant level, that method is one that encourages choices that are reasonably close to those that are optimal for the firm as a whole.

The division managers should be concerned with maximizing their profit given a particular allocation method, while the firm's problem is to maximize total profit given the cost function of the service department. Thus, each manager is facing a profit-maximization problem that may have a solution that is different from the solution to the firm's problem. If a manager is able to solve the problem faced by his division, then his choices of maintenance may be different from the solutions to the firm's problem and closer to those of the division's problem (if the solutions are different). Thus, the allocation methods could actually draw the managers' demand levels away from the firm optimum.

Another hypothesis can be tested to determine whether this occurs. In null form,

$H4_0$: The allocation methods elicit demand levels from the divisional managers that are not significantly different from the solutions to the maximization problems faced by the managers.

A testable hypothesis, different from ones above, will exist for a particular group (method) only if the solution to the divisional problem is different from the solution to the firm's problem. The solutions to the divisional problems are needed to determine the individual hypotheses that will be tested. Due to the varying complexity of the allocation methods used in this study, some groups are faced with divisional problems that are easier to solve.

Finally, there is one other reason why the division managers' choices of maintenance may be different from those that are optimal for the firm, or different from the solutions to the divisional problems. The costs allocated under methods M2, M3, M5, and M6 are based on the amounts demanded by both divisions. Thus, the allocation to one division depends on the choice made by the other division. Since the allocations are likely to influence later choices, the choices of one manager may be dependent on the other manager's choices.

Because of this potential dependence among the choices made by paired subjects, some of the above hypotheses involving M2, M3, M5, and M6 are tested again, using data for the paired subjects. In particular, the $H4_0$ hypotheses, comparing the maintenance levels chosen to the solutions to the divisional problems, are tested with a different set of data. These are designated H50, but are really additional tests of the null hypothesis $H4_0$.

PARAMETERS OF THE EXPERIMENT

The cost function for the service department and the function relating increases in profit to units of maintenance parameterize the experiment. The "profit" function reflects benefits received from requesting maintenance, and must increase at a decreasing rate. If a manager's choice of maintenance in operating period i is x_i, then the increase in profits (the upward shift in the range of point values) due to that amount of maintenance is defined as $M(x_i) = 70 \cdot \ln[(x_i/4)+1]$. This functional relationship between maintenance demanded and the resulting benefits is the same for both divisions and the same for all operating periods and rounds. The table available to the subjects shows how far the initial range of point values will shift for various choices of maintenance.

The cost function for the maintenance department must be marginally increasing, and must result in no costs if no maintenance is demanded by either manager. A quadratic function is used to capture these features. If x_i and y_i represent the choices of maintenance in operating period i by the managers of divisions A and B respectively, then the total maintenance cost for operating period i is defined as $C(x_i,y_i) = (1/6)(x_i+y_i)2$. Given this function and the function relating increases in divisional profits to maintenance, the firm's profit-maximization problem can be set up and solved.

The sum of the expected profits from both divisions equals total revenue for the firm, and costs are those of the maintenance department. Other costs are considered negligible for this research setting. Expected profit must be added over the four operating periods since optimal levels of maintenance will be different in each operating period. So the firm's profit-maximization problem is to select x_i and y_i for operating periods 1 through 4 so as to maximize the sum of the expected profits minus costs: Sum $[E(Profit_A(x_i)) + E(Profit_B(y_i)) - C(x_i,y_i)]$ over the four operating periods. Substituting functional notation and then the actual parameters of this particular scenario, the problem to solve becomes:

$$Sum_{(i = 1,2,3,4)} \{E[s_i + M(x_i) + a] + E[t_i + M(y_i) + b] - C(x_i,y_i)\} =$$
$$Sum_{(i = 1,2,3,4)} \{s_i + 70 \cdot \ln[(x_i/4)+1)] + 50 + t_i + 70 \cdot \ln[(y_i/4)+1] + 50 - (1/6)(x_i+y_i)^2\}$$

where:

x_i is division A's demand in period i, i = 1,2,3,4;
y_i is division B's demand in period i, i = 1,2,3,4;
M() is the function relating increased profit with maintenance;
C() is the cost function of the maintenance department;
s_i is the value at the lower end of the deteriorated range for division A in period i;
t_i is the value at the lower end of the deteriorated range for division B in period i;
$s_1 = t_1 = 750$;
$s_{i+1} = s_i + M(x_i) – 150$, i = 1,2,3;
$t_{i+1} = t_i + M(y_i) – 150$, i = 1,2,3;
a is a random variable, distributed Unif(0,100);
and b is a random variable, distributed Unif(0,100).

Since the profit functions are the same for both divisions, the optimal solution has $x_i^* = y_i^*$, for i = 1,2,3,4, and $(x_1^*,x_2^*,x_3^*,x_4^*) = (y_1^*,y_2^*,y_3^*,y_4^*) = (18.59, 15.86, 12.63, 8.44)$, where these are units of maintenance. An important characteristic of this solution is that the optimal amounts of maintenance decrease over time. This is due to the sequential nature of the operating periods. (The details of calculating this solution are available from the authors.)

How the allocation methods are implemented can now be more completely explained. Method M2 allocates at average unit cost. Thus, if divisions A and B demanded x_i and y_i respectively, total cost would be $(1/6)(x_i+y_i)^2$, average unit cost would be $(1/6)(x_i+y_i)$, and allocations would be $(1/6)(x_i+y_i)x_i$ and $(1/6)(x_i+y_i)y_i$. Method M3 is the ad hoc method incorporating higher average unit costs if the total demand level is too high. In situations where one or both of the divisions cause the total demand to be greater than optimal total demand, this method uses the optimal average unit costs to allocate some of the costs of the maintenance department. The optimal average unit cost is different for each operating period, and is 6.20, 5.29, 4.21, and 2.81 for operating period 1, 2, 3, and 4, respectively. Details of this method were explained in an earlier section.

A predetermined rate is used to allocate maintenance department costs under method M4. The rate used in this study is approximately equal to the average of the optimal average unit costs over the four operating periods, which is 4.6275 points. This average is rounded to 4.5 points, and this is used as the charge per unit of maintenance demanded. Method M5 charges the divisions for the maintenance demanded at the marginal cost at the total demand level. Marginal cost at demand levels x_i and y_i, $MC(x_i,y_i) = (1/6) \cdot 2 \cdot (x_i+y_i) = (1/3)(x_i+y_i)$. Costs allocated to the divisions are then $(1/3)(x_i+y_i)x_i$ and $(1/3)(x_i+y_i)y_i$. The sixth allocation method used in this study is Shapley value allocations. Method M6 is described to the subjects as the average of the incremental costs when the divisions are serviced in different orders by the maintenance department. However, in this two-division setting, Shapley value allocations are equivalent to average cost allocations (those under method M2).

For all methods, the subjects are given a description of, and in some cases, a numerical example to illustrate, the allocation method. They also know that the cost function is marginally increasing in units of maintenance demanded. Any information about the magnitude of the costs or unit charges must be inferred from the amounts allocated in various operating periods.

INFORMATION AVAILABLE TO THE SUBJECTS

Initially the managers have little information about the costs to be allocated to them - they know only the allocation method to be used and the general shape of the cost function. To aid the subjects in their decision-making task, the supervisor explains several points before the computerized exercise begins. Since the consecutive operating periods result in optimal solutions that decrease over time, a general comment is made to the subjects regarding the effects the choices of maintenance would have on the following operating periods. They are not told specifically of the decreasing nature of the optimal solutions, but it is mentioned that the effects of their choice in the first operating period would carry through all four periods, whereas that in the fourth period would have only a one-period effect. It is suggested that they try several combinations of maintenance levels during the initial rounds to examine the effects of these combinations on their performance points.

The computer program also makes available to the subjects a variety of information at different stages of the computerized exercise. At certain points during each operating period, the subject has the option of viewing different types of information. At the beginning of each operating period, the deteriorated range is displayed, along with the table showing how far various amounts of maintenance will shift the range. For the first operating period, this table is identical to the paper copy they each have available at their workstations. The table also shows the level of maintenance above which no additional benefit from maintenance is derived. The subject also has the option of reviewing the results of previous operating periods on the screen. This review screen shows the deteriorated range, the units of maintenance chosen, the final range, and performance points for each operating period in every round completed to that point in the exercise.

After the subjects make their choices of maintenance, the computer program gives the results for that operating period. This results screen displays the units of maintenance chosen, the final range, the period results (the random draw from the final range), the cost allocation, and the performance points earned for the operating period. If it is the fourth operating period (the end of a round), the results screen also shows the average performance points per operating period, the random draw from the range of possible values (for the cost allocation method used), and whether the subject won $2. Once ready to continue, the subject continues with another round.

Another sheet of paper that is made available to the subjects is a chart, in matrix form, which allows the subject to record information about each operating period in an organized manner. It is suggested by the supervisor that they record their choices of maintenance and resulting cost allocations on this information chart, and that they calculate the cost per unit. Many subjects also record other information from the results screen.

RESULTS AND TESTS OF THE HYPOTHESES

The responses made by the subjects in the computerized exercise provide data with which to test the hypotheses. Since the experiment is designed with consecutive operating periods and a different amount of maintenance is optimal for each operating period, tests of the hypotheses are multivariate tests. When comparing mean responses between groups, the tests are based on vectors of the means of each operating period. The two versions of the Hotelling T^2 statistic are used.

The computerized exercise was conducted with one hundred ten (110) subjects who volunteered to participate in this study. Payments to the subjects ranged from $10 to $16. (Five (5) subjects actually earned less than $10 during the experiment, but were paid $10 since the subjects were guaranteed a minimum of $10 for participating.) A total of 10 subjects earned the maximum amount. There were eighteen (18) subjects in each of groups M1 through M5 and twenty (20) subjects in group M6.

The experiment does not allow for easy determination of the cost of maintenance. A subject gains some information through the cost allocation made for the amount of maintenance demanded as the operating periods and rounds continue. Also they must familiarize themselves with how the exercise works. By the later rounds the subject should make choices of maintenance that are more consistent round to round. Therefore, the analysis for this study is also done based on only the last three (3) rounds of the experiment. (The hypotheses were also tested using all eight rounds of data. Unless otherwise noted, the results were similar with both sets of data.)

For all subjects in a group, the maintenance choices are averaged over the last three rounds by operating period. These mean maintenance levels are presented in Table 1 by allocation method. These means, in vector form, are used in the statistical tests of the hypotheses.

Table 1: Mean Maintenance Levels Demanded By Subjects By Method and Operating Period

Method	No. of Observations	Period 1	Period 2	Period 3	Period 4
M1	54	27.78	28.85	29.78	29.12
M2	54	13.89	13.44	12.74	10.77
M3	54	13.57	11.89	11.71	11.72
M4	54	19.70	17.61	15.31	14.64
M5	54	10.45	9.38	9.31	7.74
M6	60	14.05	12.18	14.21	10.71

The number of observations used to calculate the means for methods M1 through M5 was 54 (18 subjects times 3 rounds), and for method M6 was 60 (20 subjects times 3 rounds).

To test hypothesis $H1_0$, the vector of mean maintenance demands for each group facing a cost allocation method is compared to the vector of mean maintenance demands for group M1, the group facing no allocation method. A version of the Hotelling T^2 statistic (Bolch and Huang 1974: 90) is used to test the null hypothesis that the vectors of means are equal. Let Wi represent the vector of mean maintenance demands for group Mi (over the last three rounds). Table 2 presents the calculated T^2 statistics for the five comparisons and the critical values of T^2 at various alpha levels. The hypothesis is rejected at the .001 level in all five cases. Comparing the calculated and critical values, levels of maintenance chosen when costs are allocated are significantly different from the amounts chosen when no costs are allocated.

Table 2: Testing Hypothesis $H1_0$: Comparing Mean Demand Levels for Allocation Methods to Mean Demand Levels with No Cost Allocation

Comparison	Calculated T^2	Degrees of Freedom
W2 vs. W1	661.47*	(4,103)
W3 vs. W1	758.71*	(4,103)
W4 vs. W1	210.07*	(4,103)
W5 vs. W1	983.59*	(4,103)
W6 vs. W1	639.58**	(4,109)

Calculated T^2 values = N (Wi - W1)' S^{*-1} (Wi - W1) where $N = (n_i \cdot n_1)/(n_i + n_1) = 27$ for i = 2,3,4,5 and N = 28.421 for i = 6.

Degrees of freedom = (p, n_i+n_1-p-1)
* Critical values of T^2 for degrees of freedom (4, 100): $T^2(.05) = 10.14$; $T^2(.01) = 14.46$; $T^2(.001) = 20.89$
** Critical values of T^2 for degrees of freedom (4, 100): $T^2(.05) = 10.11$; $T^2(.01) = 14.43$; $T^2(.001) = 20.84$

The next hypotheses involve the ad hoc method that includes opportunity costs and one that does not. Hypothesis $H2_0$ tests whether the mean demand levels for these two allocation methods are equal. Panel A of Table 3 shows the calculated and critical T^2 values for testing this hypothesis. The mean demand levels for these two allocation methods are significantly different at the .05 level. (Using all eight rounds of data, they were different at the .01 level.)

Also of interest is whether either of these methods encourages demand levels that are close to those that are optimal for the firm. Testing these hypotheses, designated $H3A_0$ and $H3B_0$, requires use of a different form of the Hotelling T^2 statistic. The comparisons are made between the mean demand levels under the two methods and the solution to the firm's problem, which is designated m*. Panel B of Table 3 shows the calculated and critical T^2 values and a comparison reveals that the demand levels under both of these methods are significantly different from the firm's profit-maximizing solution at the .001 level.

To measure the closeness of the vectors of mean demand levels to the vector of optimal choices of maintenance Euclidean distance is used. The distance between W2 and m* is 5.7757, and between W3 and m* is 7.2512. (Using all eight rounds of data, the distances were 5.9678 and 7.2851, respectively.) These results do not support Zimmerman's idea that by incorporating costs of externalities into an allocation method, managers should choose amounts that are closer to what is optimal.

Table 3: Panel A: Comparing M2 and M3: Results of Hotelling T^2 Tests of $H2_0$: W2 = W3

Comparison	Calculated T^2	Degrees of Freedom		
W2 vs. W3	12.92	(4,103)		
Degrees of freedom = (p, n_2+n_3-p-1); $n_2 = n_3 = 54$.				
Critical values of T^2 for degrees of freedom (4, 100): $T^2(.05) = 10.14$; $T^2(.01) = 14.46$; $T^2(.001) = 20.87$				
Panel B: T^2 Tests of $H3A_0$: W2 = m* and $H3B_0$: W3 = m*				
Hypothesis	Comparison	Calculated T^2	n_i	Degrees of Freedom
$H3A_0$	W2 vs. m*	73.10	54	(4, 50)
$H3B_0$	W3 vs. m*	466.10	54	(4, 50)
Calculated T^2 values = $n_i(Wi - m^*)' S^{-1} (Wi - m^*)$				
Degrees of freedom = (p, n_i-p) Critical values of T^2 for degrees of freedom (4, 50): $T^2(.05) = 10.85$; $T^2(.01) = 15.77$; $T^2(.001) = 23.32$				

The next hypotheses compare the mean responses for methods M1, M4, M5, and M6 to the solution to the firm's profit-maximization problem. Of interest is whether any of these methods encourage choices of maintenance that are equal to the optimal choices. Table 4 presents the calculated and critical T^2 values for the four hypotheses. Comparing these values shows that the mean response vectors are significantly different from the optimal responses at the .001 level.

Table 4: Testing Hypothesis $H3_0$: Comparing Mean Demand Levels to the Firm's Optimal Levels

Hypothesis	Comparison	Calculated T^2	n_i	Degrees of Freedom
$H3C_0$	W1 vs. m*	4262.09#	54	(4, 50)
$H3D_0$	W4 vs. m*	42.13#	54	(4, 50)
$H3E_0$	W5 vs. m*	181.20#	54	(4, 50)
$H3F_0$	W6 vs. m*	139.93##	60	(4, 56)
Calculated $T^2 = n_i (Wi - m^*)' S^{-1} (Wi - m^*)$				
Degrees of freedom = (p, n_i-p) # Critical T^2 for degrees of freedom (4, 50): $T^2(.05) = 10.85$; $T^2(.01) = 15.77$; $T^2(.001) = 23.32$ ## Critical T^2 for degrees of freedom (4, 50): $T^2(.05) = 10.79$; $T^2(.01) = 15.68$; $T^2(.001) = 21.36$				

To maximize the money they earn during the experiment, subjects choose maintenance levels that will keep their average performance points as high as possible. If the division managers try to maximize profit given the cost allocation method they are exposed to, they may be drawn away from the solution that is optimal for the firm. This may be the case for those methods where the solution to the divisional problem is different from that of the firm's problem. Table 5 displays the solutions to the firm's problem and the divisional problems. This table shows that the solution to the problems for methods M1, M4, and M5 are different from the solution to the firm's problem.

Table 5: Solutions to the Profit-Maximization Problems (In Units of Maintenance)

	Operating Period	1	2	3	4	Notation
Firm's Problem:		18.59	15.86	12.63	8.44	m*
Manager's Problem for Group:	M1	30.095	30.095	30.095	30.095	m1*
	M2	18.59	15.86	12.63	8.44	m2*
	M3	18.59	15.86	12.63	8.44	m3*
	M4	58.22	42.66	27.11	11.55	m4*
	M5	12.965	10.71	8.44	5.515	m5*
	M6	18.59	15.86	12.63	8.44	m6*

The details of the solution to the firm's problem and to the problems faced by managers in each group are available from the authors.

To test hypothesis $H4_0$, these solutions are compared to the mean vectors of responses for groups M1, M4, and M5 using a form of the Hotelling T^2 statistic. Table 6 presents the calculated and critical T^2 values for these three tests. A comparison among the values shows that responses in the groups were significantly different from the solutions to the respective divisional problems, at the .05 level for group M1, and at the .001 level for groups M4 and M5. (The responses were significantly different from the divisional solutions at the .001 level for all three of these groups using all eight rounds of data.)

Table 6: Calculated T^2 Values for Testing $H4A_0$, $H4B_0$, and $H4C_0$

Hypothesis	Comparison	Calculated T^2	Degrees of Freedom
$H4A_0$	W1 vs. m1*	13.67	(4, 50)
$H4B_0$	W4 vs. m4*	1356.42	(4, 50)
$H4C_0$	W5 vs. m5*	31.74	(4, 50)

Calculated T^2 values = $54\ (Wi - mi^*)'\ S^{-1}\ (Wi - mi^*)$

Degrees of freedom = $(p, n_i\text{-}p)$
Critical values of T^2 for degrees of freedom (4, 50): $T^2(.05) = 10.85$; $T^2(.01) = 15.77$; $T^2(.001) = 23.32$.

Finally some of the $H4_0$ hypotheses are tested again, due to the potential dependence among the responses made by paired subjects. A new data set is created by concatenating the vectors of responses of the subjects who are paired into single vectors of length eight. Table 7 presents the mean maintenance levels by division for the six groups. The optimal vectors and the vectors of sample means (of length eight) are formed like the new data set, by concatenation, and these vectors are designated mi_8* and Wi_8, respectively.

Table 7: Mean Maintenance Levels Demanded By Subject-Pairs by Division

		Operating Period	1	2	3	4
Group	Division	n				
M1	A	27	28.036	28.593	30.629	29.815
	B	27	27.519	29.111	28.926	28.426
M2	A	27	12.816	13.072	13.207	12.383
	B	27	14.963	13.815	12.267	9.148
M3	A	27	11.554	10.848	10.380	10.699
	B	27	15.593	12.927	13.037	12.750
M4	A	27	19.407	16.407	15.000	15.037
	B	27	20.000	18.815	15.630	14.241
M5	A	27	9.824	8.720	8.138	7.431
	B	27	11.076	10.030	10.491	8.039
M6	A	30	15.960	14.225	15.810	12.775
	B	30	12.133	10.133	12.617	8.650

The number of observations used to calculate the means for methods M1 through M5 was 27 (9 subject-pairs times 3 rounds), and for method M6 was 30 (10 subject-pairs times 3 rounds).

Table 8 presents the calculated T^2 values and critical T^2 values for the appropriate form of the Hotelling T^2 test for the four $H4_0$ hypotheses tested again. By comparing the values, the four versions of the null hypothesis can be rejected at the .001 level. These results are similar to those for the $H4_0$ hypothesis tests, and show us that the subjects were not able to solve the divisional problems.

Table 8: Testing Hypotheses with Data from Paired Subjects				
Hypothesis	Comparison	Calculated T^2	n_i	Degrees of Freedom
$H5A_0$	$W2_8$ vs. $m2_8$*	663.04+	27	(8, 19)
$H5B_0$	$W3_8$ vs. $m3_8$*	753.29+	27	(8, 19)
$H5C_0$	$W5_8$ vs. $m5_8$*	92.70+	27	(8, 19)
$H5D_0$	$W6_8$ vs. $m6_8$*	281.28++	30	(8, 22)
Calculated T^2 values = $n_i (Wi_8 - mi_8^*)' S^{-1} (Wi_8 - mi_8^*)$				
Degrees of freedom = $(p, n_i\text{-}p)$ + Critical value of T^2 for degrees of freedom (8, 19): $T^2(.05) = 27.15$; $T^2(.01) = 39.74$; $T^2(.001) = 62.62$ ++ Critical value of T^2 for degrees of freedom (8, 22): $T^2(.05) = 25.31$; $T^2(.01) = 36.38$; $T^2(.001) = 55.04$				

CONCLUDING REMARKS

This study examines the effects of different cost allocation methods on demands for a common resource provided by a centrally-run service department. It represents one of the few empirical studies testing propositions from Zimmerman (1979) and it uses an experimental approach.

The results of the hypothesis tests suggest that cost allocation methods are beneficial in that they result in demand levels which are closer to the firm's optimal levels than the demand levels resulting when no costs are allocated to the divisional users. The results of this study do not support the hypothesis that a cost allocation method that incorporates the costs of externalities results in actions by divisional managers that are closer to what is best from the firm's perspective than a method that does not incorporate such costs.

Other results of this study show that under the scenario examined here, the subjects (division managers) chose levels of maintenance that were significantly different from the firm's optimal levels and the levels that would be best from a divisional standpoint for all six groups. This is not totally unexpected in that the subjects had very little information about the cost function for maintenance.

Further research, where more information is available to the subjects, could provide some insight into whether the lack of information was a critical factor in determining the results of this study. The data from this study could also be used to develop possible models to explain how maintenance choices were made. Such a study could provide some insight into the effects of different cost allocation methods on managerial decision-making behavior.

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THE CHANGE IN THE BEHAVIOR OF ODD-LOT SHORT SELLERS

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ABSTRACT

Technical indicators of individual investor behavior using odd-lot short selling have been widely studied. Contrarians employ these indicators in their investment strategies because they feel that individual investors who utilize odd-lot short selling tend to get into or out of the market at precisely the wrong times. These technical indicators have even appeared in popular investments textbooks. The current study indicates that these indicators are no longer valid indicators of individual investor behavior.

Daily odd-lot short selling is examined for the period 1970 through 1995 using a generalized autoregressive conditional heteroscedatic (GARCH) model. Results for the period 1970 through 1985 are consistent with previous studies of individual investor behavior. Both a day of the week effect and a turn of the year effect were present. Additionally, odd-lot short selling was significantly related to the previous day's price change.

Results for the period 1986 through 1995 differ significantly from the earlier period. The evidence indicates that individual investors no longer dominate this market. Professional traders now dominate this market. Neither the day of the week effect nor the turn of the year effect were statistically significant, and odd-lot short sales were not related to the previous day's price change.

INTRODUCTION

Technical trading rules based upon odd-lot short sales assume that the trades are being done by unsophisticated individual investors. Heavy odd-lot short selling by individuals is interpreted as a bullish signal to other, more informed, investors (Reilly & Brown, 2000; Colby & Meyers, 1988). Conversely, light odd-lot short selling by individuals is interpreted as a bearish signal.

Today odd-lot sales are just as likely to be made by professional traders as by individuals. One of the requirements of short selling is that it can be accomplished only after an uptick. However, odd-lot short sellers are guaranteed of being able to sell at the next uptick. Professional traders can use odd-lot short selling in an attempt to make arbitrage profits. In fact, Norris (1986) claims that the dominant traders in odd-lot short sales are professional traders rather than unsophisticated individuals.

This study investigates the day of the week effect, the turn of the year effect, the holiday effect, and the previous day price change effect for the period 1970 through 1995. The total sample was split into two parts. One part covered the period 1970 through 1985 and the other part covered the period 1986 through 1995. The results indicate the existence of a day of the week effect, a turn of the year effect, and a previous day price change effect in the first period. The day of the week effect and a turn of the year effect have been documented for individual investors by many other researchers. This day of the week effect, turn of the year effect, and previous day price change effect are not statistically significant during the later period of the study.

We employ a generalized autoregressive conditional heteroscedasticity (GARCH) model. This statistical methodology is an improvement over an equality of means test. Equality of means tests implicitly assume (1) that each daily observation is independent of observations from previous days and (2) that the variance is constant over the time period of the study. Although this approach is widely used to investigate the day of the week effect, the turn of the year effect, and the holiday effect in rate-of-return studies, such a statistical approach may be invalid in studies where the dependent variable is dependent upon observations from prior days or where the variance of the error in the model is not constant. Furthermore, an equality of means type test cannot easily be extended to consider simultaneous effects that variables may have on each other. The GARCH model corrects for these weaknesses. The empirical results from this study indicate that odd-lot short sales follow such a model.

This paper consists of the following five sections. The first section is a review of the literature on the behavior of the individual trader. The second and third sections describe the data and the methodology respectively. The fourth section presents the results of the study and is followed by a summary and conclusion.

REVIEW OF THE LITERATURE

Recent studies on stock market activity have investigated the relationship between the behavior of individual investors and certain stock market anomalies. Lakonishok and Maberly (1990) argue that individual investors are likely a cause of the negative returns observed on Mondays because individual investors analyze and/or evaluate their portfolios on the weekend and then institute their trades on Mondays. Lakonishok and Maberly find that the ratio of odd-lot sales minus odd-lot purchases divided by New York Stock Exchange (NYSE) trading volume was highest on Mondays indicating that individual investors sell more shares on Monday than on any other day of the week and therefore appear to have more influence on the market on Mondays. They also find that NYSE block volume as a percentage of total NYSE volume was lowest on Mondays indicating that institutional investors tend to be less active in the market on Mondays.

Dyl and Maberly (1992) suggest that the January effect is influenced by the trading of individual investors. They observe that the ratio of odd-lot sales to odd-lot purchases is dramatically higher at the close of the year relative to the beginning of the subsequent year. Ritter (1988) finds the mean daily buy/sell ratio of cash account customers of Merrill Lynch, Pierce, Fenner, and Smith is lower at the end than at the beginning of the year. Ritter suggests that this activity may be related to the tax-loss selling in December following bear markets and the parking of the proceeds until January.

Dyl and Maberly also notice that the ratio of odd-lot sales to odd-lot purchases is extremely high two days before Christmas and two days before New Year's Day. They suggest that this behavior may explain the high positive returns on the trading day immediately preceding these two holidays (Pettengill, 1989; Ariel, 1990).

DATA

Aggregate daily odd-lot short selling data for the NYSE were obtained from various issues of Barron's for the period 1970 through 1995. Daily short sales figures were checked for errors against both weekly totals for odd-lot short selling, which appear in Barron's, and against daily odd-lot short selling, which appear in the Wall Street Journal. Aggregate daily trading volume of the NYSE and the level of the NYSE Composite Index were obtained from Barron's.

METHODOLOGY

Generalized autoregressive conditional heteroscedastic (GARCH) models have frequently been applied to the analysis of financial time series (Engle et al., 1987; De Jong et al., 1992; Kodres, 1993; Vlaar & Palm, 1993). The GARCH model allows the conditional variance of the error term in a linear regression model to evolve over time.

The following GARCH model was investigated in this paper:

LPSHORTt = ß0 + ß1LPSHORTt-1 + ß2LPSHORTt-2 + ß3LPSHORTt-3 +
ß7M + ß8T + ß9W + ß10F + ß11DEC + ß12JAN + ß13PREH1 + ß14PREH2 +
ß15POST1 + ß16POST2 + ß17LNYSE1 + vt
vt = et - 1vt-1 - 2vt-2 - 3vt-3 - 4vt-4 - 5vt-5 - 6vt-6 - 7vt-7 - 8vt-8 -
9vt-9 - 10vt-10 - 11vt-11 - 12vt-12 - 13vt-13 - 14vt-14 - 15vt- 15 -
16vt-16 - 17vt-17 - 18vt-18 - 19vt-19 - 20vt-20,
et = ut ht,
ht = 0 + 1et-12 + 1ht-1 + 2ht-2,

where ut is an independent normally distributed random variable at time t with a mean of zero and a variance of one. The variables in the above equation are defined in Table 1. The variance vt is the conditional error at time t. It has both an autoregressive component and heteroscedastic component. The coefficients in the equation for the heteroscedastic component ht are constrained to be greater than or equal to zero in the maximum likelihood estimation procedure to ensure that ht is always positive.

Table 1: Variable Definitions
LPSHORTt = Natural logarithm of one plus the rate of change in short selling for day t.
LVOLD = Natural logarithm of one plus the rate of change for volume of trading on the NYSE for day t.
M = 1 if day t is Monday; 0 otherwise.
T = 1 if day t is Tuesday; 0 otherwise.
W = 1 if day t is Wednesday; 0 otherwise.
F = 1 if day t is Friday; 0 otherwise.
DEC = 1 if day t is in December; 0 otherwise.
JAN = 1 if day t is in January; 0 otherwise.
PREH1 = 1 if day t is one day prior to a holiday; 0 otherwise.
PREH2 = 1 if day t is two days prior to a holiday; 0 otherwise.
POST1 = 1 if day t is one day after a holiday; 0 otherwise.
POST2 = 1 if day t is two days after a holiday; 0 otherwise.
LNYSE1 = Natural logarithm of one plus the rate of change in the NYSE stock price index for day t-1.

The dependent variable LPSHORTt is the natural logarithm of one plus the rate of change in the number of aggregate odd-lot shares sold short on the NYSE. Since the number of odd-lot shares sold short increased dramatically over the period from 1970 - 1995, the rate of change is a more appropriate dependent variable then simply the number of odd-lot shares sold short. The number of odd-lot shares sold short each day was highly variable. For instance, the sales on day t might be 100,000 shares, the sales on day t+1 might be 400,000 shares, and the sales on day t+2 might revert back to 100,000 shares. The rate of change from day t to day t+1 is 3.00, while the rate of change from day t+1 to day t+2 is -.75. Because of this asymmetric movement in the rate of change, the dependent variable was chosen to be the natural logarithm of one plus the rate of change in the number of odd-lot shares sold. In this case, the dependent variable for the rate of change from day t to day t+1 is ln(1+3.00), which is 1.3863, and the dependent variable for the rate of change from day t+1 to day t+2 is ln(1-.75), which is -1.3863.

The first set of independent variables in the model consists of LPSHORTt-1, LPSHORTt-2, and LPSHORTt-3. These variables are the dependent variable at time t lagged one through three days, respectively. The variables M, T, W, and F are zero-one independent variables representing days of the week. Since no variable is defined for Thursday, the coefficients of variables M, T, W, and F represent the difference in the dependent variable on those days compared to the level of the dependent variable on Thursday. Lakonishok and Maberly (1990) observe that the ratio of odd-lot sales minus odd-lot purchases divided by New York Stock Exchange (NYSE) trading volume is highest on Mondays. If any of the current coefficients are statistically significant, then a day of the week effect exists in the behavior of odd-lot short sellers.

Two variables are assigned to represent odd-lot short sales in either December or January. These zero-one dummy variables are DEC and JAN. Dyl and Maberly (1992) report that the ratio of odd-lot sales to odd-lot purchases is dramatically higher at the close of the year relative to the beginning of the next year. Brent et al. (1990) suggest that individual investors may increase their short selling in December for tax reasons. Investors who want to postpone payment of taxes on gains from holding common stock may sell short common stocks which they own to lock in their profit for the year. Investors would then recognize their gain in the next tax year by closing out their positions in the next year. Researchers have also observed that the month of January is unique because it has higher excess returns and stock price volatility than other months (Glosten, et al., 1993).

Variables PREH2, PREH1, POST1, and POST2 capture the potential holiday effect. These variables are zero-one variables which identify the day two days before a holiday, one day before a holiday, one day after a holiday, and two days after a holiday respectively. Dyl and Maberly (1992) observe different behavior of individual investors in purchases and sales of odd-lots on the NYSE prior to the Christmas and New Years Day holidays but did not investigate investor behavior around other holidays. If any of the four variables above are statistically significant, then a holiday effect exists for odd-lot short sellers.

Another independent variable is VOLD, which is the natural logarithm of one plus the rate of change in volume of shares traded on the New York Stock Exchange (NYSE) on day t. This variable measures the change in the level of trading by all investors on the NYSE for day t. The change in odd-lot short sales should be positively related to this variable.

The last independent variable is LNYSE1, which is the natural logarithm of one plus the rate of change in the NYSE stock price index for the previous day. This variable was included in the model to determine whether odd-lot short sellers react in a belated manner to changes in stock prices. Some researchers argue that short sellers are contrarians (Hanna, 1976). If this is indeed the case, then short selling should increase as stock prices increase and the coefficient of this variable should be positive. However, if individual investors react in concert with the market in a belated manner, their short selling will increase after the market falls and decrease after the market rises. This behavior will be reflected by a negative coefficient.

RESULTS

This section is divided in two parts. The first portion contains some descriptive information about the dependent variable, while the second portion discusses the results from the GARCH model. Table 2 shows the mean and standard deviation for the dependent variable broken down by day of the week, month of the year, and holiday effect. The first section of the table analyzes the day of the week effect. Although the means vary across days of the week, the analysis of variance test for the equality of means across days of the week does not reject the null hypothesis that the means are the same across all days of the week at the .05 significance level. The second section of the table gives the mean of the dependent variable grouped into three different categories, December, January, and all other months. The null hypothesis that the means are the same across the three categories cannot be rejected at the .05 significance level. The third section is related to the holiday effect. The dependent variable was broken down into five different categories. The null hypothesis that the means are the same across the five categories is rejected at the .01 level. The hypothesis tests discussed in this section may be inaccurate because the analysis of variance test assumes that each daily observation is independent of observations for the prior days and that the variance is constant over time. These weaknesses do not exist in the GARCH model.

Table 2: Test for Differences in Means
Years 1970-1995

Days of the Week Variable	Mean	Standard Deviation	Number of Observations
M	.00262	.80235	1256
T	-.00179	.78624	1341
W	.03801	.70422	1345
R	-.01638	.72510	1318
F	-.02015	.74393	1310
Analysis of Variance Test for Equality of Means			
F = 1.25			
Month of the Year Variable	**Mean**	**Standard Deviation**	**Number of Observations**
December	-.00823	.68586	548
January	.01983	.77827	550
All other months	-.00043	.75667	5472
Analysis of Variance Test for Equality of Means			
F = .22			
Holiday Effect Variable	**Mean**	**Standard Deviation**	**Number of Observations**
Two days prior to holiday	.02330	.71878	209
One day prior to holiday	-.16097	.86568	210
One day after holiday	.11686	.96554	208
Two days after holiday	.09546	.79968	207
All other days	-.00194	.73799	5736
Analysis of Variance Test for Equality of Means			
F = 4.55*			
* Significant at .01 level.			

The results from the GARCH model for the entire 1970 - 1995 period are presented in Table 3. The parameters presented in Table 3 were obtained by maximizing the likelihood function for the model. The likelihood ratio test was performed to determine if additional variables should be added to the equations for LPSHORTt, vt and ht. The two variables considered for inclusion in the equation for LPSHORTt were LPSHORTt-4 and ht, while vt-21 was tested for inclusion in the equation for vt. The variables et-22 and ht-3 were considered for addition to the equation for ht. The coefficients for the terms in the equation for ht were constrained to be positive in the estimation process. Therefore, the likelihood ratio test criterion for verifying the null hypothesis was taken from the table in Kodde and Palm (1986). The addition of either et-22 or ht-3 to the equation for ht did not increase the explanatory power of the model. Vlaar and Palm (1993) applied this procedure to select the number of lag terms for their GARCH model. The likelihood ratio test could not reject the null hypothesis (at the .05 significance level) for any of the above mentioned cases.

Table 3: Estimates of Model Parameters
Years 1970-1995

Variable	Coefficient	t-Statistic
Equation LPSHORTt		
Intercept	-.01293	-.980
LPSHORTt-1	.13583	3.906*
LPSHORTt-2	-.09133	-2.546**
LPSHORTt-3	-.11862	-3.211*
LVOLD	.63361	20.516*
M	.09598	5.149*
T	-.06978	-3.704*
W	.02318	1.005
F	.01966	.865
DEC	-.02827	-5.595*
JAN	.01810	3.655*
PREH1	-.04764	-1.432
PREH2	-.02411	-.822
POST1	.09814	2.887*
POST2	-.03638	1.208
LNYSE1	-2.99490	-7.926*
Equation vt		
vt-1	.71317	19.743*
vt-2	.48629	9.752*
vt-3	.28189	6.351*

Table 3: Estimates of Model Parameters Years 1970-1995		
Variable	Coefficient	t-Statistic
vt-4	.24389	7.312*
vt-5	.23331	9.573*
vt-6	.22453	11.927*
vt-7	.20521	10.519*
vt-8	.19751	9.809*
vt-9	.17143	8.471*
vt-10	.15018	7.865*
vt-11	.14695	8.086*
vt-12	.13840	7.570*
vt-13	.15407	8.401*
vt-14	.13366	7.347*
vt-15	.12999	7.128*
vt-16	.12121	6.706*
vt-17	.10213	5.759*
vt-18	.07518	4.380*
vt-19	.05293	3.302*
vt-20	.03509	2.696*
Equation ht		
Intercept	.00070	2.843*
et-12	.05899	9.594*
ht-1	.29463	9.308*
ht-2	.64465	20.294*
* Significant at .01 level. ** Significant at .05 level.		

The empirical evidence indicates the dependent variable is related to its value one through three days earlier. Hence, the dependent variable does not appear to be independent of previous observations, which is assumed in an analysis of variance test for differences in the mean. The level of trading volume on the NYSE (LVOLD) is positively related to odd-lot selling activity. Since two of the coefficients related to the day of the week effect are significant, a day of the week effect is apparent. The change in odd-lot selling from Friday to Monday is statistically higher than the default level of trading from Wednesday to Thursday. Similarly, the change in odd-lot selling from Monday to Tuesday is statistically lower than trading from Wednesday to Thursday. These results are consistent with the observation of Lakonishok and Maberly (1990) that the ratio of odd-lot sales minus odd-lot purchases divided by NYSE trading volume was highest on Mondays.

A turn of the year effect is also evident in the data. The change in daily trading is smaller in December, while the change in daily trading is higher in January. Hence, the demand for odd-lot short selling is more stable in December which is consistent with the tax hedging hypothesis. The demand for odd-lot short selling is more variable in January which is consistent with the higher market volatility and excess stock returns in January (Glosten, et al., 1993).

The change in daily odd-lot short selling increases one trading day after a holiday. Such a result is not consistent with the Dyl and Maberly observation that the ratio of odd-lot sales to odd-lot purchases is high two trading days before Christmas and New Year's Day. But, the current study examined all holidays.

The change in odd-lot short selling was also related to the previous day price change. If prices rise on the NYSE, then short selling declines the next day; if prices fall on the NYSE, then short selling increases the next day.

The intricate modeling of the error term in the GARCH model had a major impact on the results. Neither the turn of the year, or holiday effect coefficients were significant at the .05 level in the ordinary least square regression equation, but one of the days of the week coefficients (Tuesday) was significant. The moving average terms in the equation for the conditional error variance vt were statistically significant at the .01 level in the GARCH model. Furthermore, each of the coefficients in the equation for ht was significant at the .05 level.

The heteroscedastic component, ht, increased dramatically starting in 1985. The level and variability of odd-lot short selling increased around this time. Norris (1986) stated: "Now the odd-lot shorting is done largely by professionals, but they act only when there is such a negative attitude in the futures pits that such shorting can lock in arbitrage profit."

The original sample was broken into two parts. One part covers the period 1970 through 1985 and the other part covers the period 1986 through 1995. Empirical results for the first period are given in Table 4. Except for the first day after a holiday, all the independent variables in the equation for LPSHORTt, which were significant in the total sample, are significant in the sample for the period 1970 through 1985. The first day after a holiday is not statistically significant---but the second day after a holiday is significant at the .05 level.

For the early subsample, each of the moving average terms in the equation for the conditional error variance, vt, were statistically significant at the .05 level. Furthermore, each of the coefficients in the equation for ht was significant at the .05 level. The main difference between the early subsample and the entire sample is related to the timing of the post holiday effect.

Table 4: Estimates of Model Parameters
Years 1970-1985

Variable	Coefficient	t-Statistic
Equation LPSHORTt		
Intercept	-.01580	-1.098
LPSHORTt-1	.14752	3.253*
LPSHORTt-2	-.08667	-2.536**
LPSHORTt-3	-.10444	-2.246**
LVOLD	.60674	17.690*
M	.11677	5.989*
T	-.06964	-3.518*
W	.02266	.920
F	.01440	.590
DEC	-.02976	-5.180*
JAN	.01850	3.008*
PREH1	-.03283	-.891
PREH2	-.04544	-1.386
POST1	.06717	1.809
POST2	.06620	1.995**
LNYSE1	-3.06898	-7.489*
Equation vt		
vt-1	.72961	15.291*
vt-2	.49826	10.816*
vt-3	.30001	5.360*
vt-4	.24630	5.534*
vt-5	.23451	7.078*
vt-6	.22580	9.193*
vt-7	.19323	7.723*
vt-8	.17886	7.105*
vt-9	.15799	6.128*
vt-10	.14580	5.847*

Table 4: Estimates of Model Parameters Years 1970-1985		
Variable	Coefficient	t-Statistic
vt-11	.14584	5.779*
vt-12	.14073	5.715*
vt-13	.15186	6.339*
vt-14	.13248	5.708*
vt-15	.12418	5.322*
vt-16	.12679	5.572*
vt-17	.10078	4.505*
vt-18	.06595	3.098*
vt-19	.04548	2.297**
vt-20	.04231	2.606*
Equation ht		
Intercept	.00096	1.861
et-12	.05620	6.490*
ht-1	.16636	2.175**
ht-2	.77257	10.358*
* Significant at .01 level. ** Significant at .05 level.		

For the subsample covering the years 1986-1995 in Table 5, both the day of the week effect and the turn of the year effect are no longer significant. Also the change in odd-lot short selling is no longer related to the change in stock prices from the previous day. The post holiday effect is, however, significant for both days after a holiday. The absence of the day of the week effect and the turn of the year effect is inconsistent with the results obtained by Lakonishok and Maberly (1990) and Dyl and Maberly (1992) respectively.

For the later subsample, each of the moving average terms in the equation for the conditional error variance vt were statistically significant at the .01 level, except for vt-20. Furthermore, only the coefficient for et-12 and for ht-1 in the equation for ht were significant at the .05 level.

Table 5: Estimates of Model Parameters Years 1986-1995		
Variable	Coefficient	t-Statistic
Equation LPSHORTt		
Intercept	.00167	.047
LPSHORTt-1	.13300	1.326
LPSHORTt-2	-.16937	-2.079**
LPSHORTt-3	-.09346	-1.031*
LVOLD	.81005	9.151*
M	-.00982	-.195
T	-.08140	-1.520
W	.02018	.344
F	.05528	.939
DEC	-.01902	-1.450
JAN	.01313	.942
PREH1	-.10414	-1.256
PREH2	.09042	1.190
POST1	.29249	3.324*
POST2	-.16399	-2.033**
LNYSE1	-1.19552	-1.120
Equation vt		
vt-1	.69593	6.812*
vt-2	.40857	3.417*
vt-3	.24462	2.920*
vt-4	.25120	3.846*
vt-5	.24884	6.956*
vt-6	.21867	6.323*
vt-7	.21169	5.775*
vt-8	.21440	6.067*
vt-9	.19036	5.534*
vt-10	.15943	4.853*
vt-11	.15217	4.951*
vt-12	.12776	4.454*
vt-13	.14926	5.419*
vt-14	.12578	4.508*
vt-15	.13634	5.064*

Table 5: Estimates of Model Parameters Years 1986-1995		
Variable	Coefficient	t-Statistic
vt-16	.10694	4.054*
vt-17	.09251	3.628*
vt-18	.07599	3.033*
vt-19	.06089	2.594*
vt-20	.02209	1.063
Equation ht		
Intercept	.00041	.647
et-12	.05188	4.261*
ht-1	.54453	2.266**
ht-2	.40307	1.724
* Significant at .01 level. ** Significant at .05 level.		

SUMMARY AND CONCLUSION

Lakonishok and Maberly (1990) and Dyl and Maberly (1992) track the aggregate behavior of odd-lot sales and purchases of stocks on the NYSE. They believe that analyzing this data would lead to a better understanding of the behavior of individual investors. Lakonishok and Maberly observed a day of the week effect, and Dyl and Maberly found a turn of the year effect.

This paper investigates the aggregate behavior of odd-lot short sellers on the NYSE. We also found a day of the week effect and a turn of the year effect for 1970-1985. However, these effects were not statistically significant for 1986-1995. The results for the 1986-1995 time period support the Norris' assertion that professional traders now dominate the market for odd-lot short sales. This assertion is further strengthened by the fact that during 1970-1985, odd-lot short selling was significantly related to the previous day's price change, whereas it was not significant during the 1986-1995 time period. The results indicate that individual investors no longer dominate the odd-lot short selling market. These findings indicate that the use of odd-lot short selling as an indicator of individual investor behavior may no longer be valid.

The generalized autoregressive heteroscedasticity technique (GARCH) improved the explanatory power of the model. The dependent variable in the model was dependent on observations from prior days and the variance of the error term did vary over the time period of this study. The results from this study indicate that the GARCH model should be applied to other studies of individual investor behavior.

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THE VALUATION IMPLICATIONS OF FUTURE INVESTMENTS IN INFORMATION TECHNOLOGY: THE CASE OF FIRM'S Y2K COMPLIANCE COSTS

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ABSTRACT

This study examines the extent to which expected future investments in information technology are value relevant. Prior research has provided mixed results on this issue. By controlling for current expenditures, and showing that the value relevance of investments in information technology is conditional on expectations of future growth, our findings provide an explanation for the contradictory results of prior research. Our findings indicate that expected future expenditures are positively valuation relevant only for high-growth firms, and this relevance is significantly greater than that of aggregate accounting earnings. The value relevance of current period Y2K expenditures is found, for both high- or low-growth firms, to be consistent with other types of expenses recognized in earnings.

Keywords: Information technology, Disclosure, Growth, Value relevance, Y2K
Data Availability: All data is available from public sources.

INTRODUCTION

Are investments in information technology [IT] value relevant? Prior research on IT investments has provided evidence to support both the predictions that IT expenditures *will*, and that they *will not* add value to a firm. By identifying a more or less experimental setting – Y2K remediation - we are able to investigate cross sectionally, whether IT investments are relevant in valuing firms, and if so, whether certain types of firms are expected to benefit more than other firms from the money spent. Such information may be of strategic value to IT managers in evaluating the type and extent of future investments in IT.

Effective June 30, 1998, the United States Securities and Exchange Commission (SEC) mandated that firms disclose whether they had determined the extent of their year 2000 (Y2K) problems, the materiality of any Y2K problems, any past (or current) expenditure for Y2K remediation and expected future Y2K remediation costs (SEC 1998). The accounting for this unique phenomenon - transforming computer systems to be Y2K compliant - created a more or less experimental setting, in that it enables us to investigate the valuation effects of a cost category that affected nearly all Western firms for a short, finite time period. Since virtually all firms had to incur and account for these IT costs, we are able to investigate whether the disclosed amounts of these costs are relevant in valuing firms, and if so, whether some firms were expected to benefit more (perceptually) than other firms from the money spent on investments in information systems.

The uniqueness of the costs associated with Y2K is that while virtually all firms were forced to incur these costs, benefits are likely to vary substantially across firms. Firms that expect to grow at rapid rates are likely justified in incurring large investments in information technology, since these investments will be put to uses that facilitate their expected growth. For such firms, disclosures of transition costs are expected to be positively value relevant, and incrementally relevant to the disclosure of aggregate accounting earnings, because these expenditures will generate future earnings beyond those reflected in current accounting earnings.

Such value relevance may not, however, exist for low-growth and no-growth firms. Like high-growth firms, low and no-growth firm's expenditures on information technology would generate future earnings, but their rate of return on these investments may be lower and thus disclosures of these costs may not be incrementally value relevant to the disclosure of aggregate accounting earnings.

In evaluating value relevance, studies such as Easton (1985), Easton and Harris (1991) and Ohlson (1995) have demonstrated that earnings and book value serve as the relevant benchmarks for valuation. Collins, et al. (1997), and Francis and Schipper (1999) extend those studies by demonstrating that – contrary to *popular wisdom* - the valuation relevance of book value and earnings has increased over time. Collins, et al. (1997), further demonstrate that their relative relevance is dependent on firm size, the existence of one-time items and the proportional magnitude of investments in intangibles, while Barth, et al. (1998), demonstrate that their relative relevance is conditional on financial health (i.e., as financial health deteriorates, the relevance of the balance sheet increases relative to the importance of the income statement). Finally, Amir and Lev (1996) use the models found in these papers as the basis for evaluating the value relevance of investments in the telecommunications industry.

By employing the valuation model from Amir and Lev (1996), we find empirical support for our expectations. Disclosures of expected future Y2K expenditures are positively valuation relevant for firms with high expected future growth [high-growth firms], but are not incrementally valuation relevant for firms with low or no expected future growth [low or no-growth firms]. The evidence suggests that for high-growth firms, planned investments in information technology are viewed as enhancing firm value. For low or no-growth firms, the evidence indicates that such investments are not distinguished from other operating expenses.

PRIOR RESEARCH

Research during the 1990s on the effectiveness of IT-related expenditures has had mixed results. Kettinger et al. (1994) find that investments in information technology do not always result in improved competitive position. Loveman (1994) likewise concludes that expenditures on non-IT inputs into production have a more positive effect than the same marginal dollars spent on IT.

Other research concludes that investments in IT have positive or mixed outcomes. Mahmood (1993) finds that organizations with greater investments in IT appear to achieve superior strategic and economic performance while Hitt and Brynjolfsson (1994) find that investment in IT leads to greater productivity and increased company value. Barua et al. (1995) find that in the manufacturing industry, investments in IT have a significant positive impact on capacity utilization, inventory turnover and product quality, but little effect on return on assets or market share. Weill (1992) finds that IT investments in one manufacturing industry are associated with higher returns on assets, sales growth, and productivity and Mitra and Chaya (1996) find that investments in IT are positively correlated with lower average production costs and lower average total costs, but higher average overhead costs.

Similarly, research on the reaction of the financial markets to investments in IT has shown mixed results. Dos Santos et al. (1993) find that while markets react differently to announcements of innovative IT investments than they do to announcements of non-innovative investments in IT, on average IT investments do not add to firm market value. Grove et al. (1990) find a negative association between market valuation and investments in IT. Alternatively, Brown et al. (1995) find that companies which invest in IT tend to be more profitable than peer firms in years subsequent to the investment, and that markets react favorably to announcements of IT investment, and Krishnan and Sriram (2000, p.95) find that total Y2K costs are positively associated with value "for the average firm." Whether future investments are viewed as favorably across a broad cross section of firms is, however, unknown.

In summary, prior research on IT investments have provided evidence to support both the prediction that IT expenditures will not add value to a firm and the prediction that IT expenditures are value enhancing. By partitioning our sample by a measure of growth, we demonstrate why both predictions can co-exist.

MODEL AND HYPOTHESES

To analyze the value relevance of IT investment, we adopt the valuation model presented in Amir and Lev (1996). This model extends the valuation models presented in Barth, et al. (1998), Collins, et al. (1997) and others by following Ohlson's (1995) incorporation of an additional vector of information within the model to represent information that is not currently reflected in either accounting earnings or net book value.

This vector is of key importance in our testing of the disclosures relating to Y2K. Y2K compliance cost disclosures are unique in that these costs are components of both current earnings and future earnings. Future earnings, by definition, are not directly reflected in either accounting earnings or net book value. Unlike other types of costs or expenses, however, current expenditures are not necessarily indicative of future expenditures since Y2K remediation is by definition, transitory in nature. The valuation model is presented below.

$$PRICE_{j,t} = \alpha_0 + \alpha_1 BV_{j,t} + \alpha_2 NI_{j,t} + \alpha_3 OTHER_{j,t} + \varepsilon_{j,t} \quad (1)$$

Where: $PRICE_{j,t}$ = the market value per share of firm *j*'s stock at time *t*;
$BV_{j,t}$ = net book value per share of firm *j*'s equity at time *t*;
Nij,t = firm *j*'s current earnings per share prior to extra-ordinary items from time *t-1* to *t*;
$OTHER_{j,t}$ = a vector of other items at time *t* affecting future earnings per share not reflected in either current net book value or current earnings of firm *j*;
$a_{0,...,3}$ = valuation coefficients;
$e_{j,t}$ = error term.

Within the context of our study, $OTHER_{j,t}$ in equation (1) represents future planned expenditures for Y2K compliance. It should be noted that the total of these future costs were not tied to a deadline of December 31, 1999, but rather that significant portions were generally related to system implementation and support that would be incurred in the year 2000 and beyond. Current expenditures for Y2K compliance is incorporated as an expense in $NI_{j,t}$. To control for the unlikely possibility that current expenditures are incrementally value relevant to other earnings components, equation (1) must be modified. We modify equation (1) by decomposing aggregate earnings ($NI_{j,t}$) into two parts: (1) the currently recognized expense for Y2K compliance; and, (2) all other components of earnings.

In addition to setting the other information vector to represent expected future Y2K compliance costs, and decomposing aggregate earnings, we also include (0,1) indicator variables to control for firms in the transportation, utilities and financial services industries. Firm observations from these industries are conventionally deleted from market studies due to the peculiarities that their regulatory environments may introduce into the financial data. We chose to control for, rather than to exclude these firms, however, because it is firms in these industries that are most likely to have their operations impacted by investments in IT (our results do not change qualitatively if these firms are excluded from our sample). The resulting equation serves as our base test model.

$$\begin{aligned} PRICE_{j,t} = \beta_0 + \beta_1 BV_{j,t} + \beta_2 NI^*_{j,t} + \beta_3 CY2K_{j,t} + \beta_4 FY2K_{j,t} \\ + \beta_5 SIC4_{j,t} + \beta_6 SIC6_{j,t} + \varepsilon_{j,t} \end{aligned} \quad (2)$$

Where: $NI^*_{j,t}$ = firm *j*'s current earnings per share prior to extra-ordinary items from time *t-1* to *t,* sans current period Y2K costs ($CY2K_{j,t}$);
$CY2K_{j,t}$ = firm *j*'s current Y2K compliance costs recognized in earnings from time *t-1* to *t*;
$FY2K_{j,t}$ = firm *j*'s disclosed expectation, at time *t*, of future Y2K compliance costs;
$SIC4_{j,t}$ = (0,1) indicator variable for Primary SIC codes 4000-4999 (transportation and utilities);
$SIC6_{j,t}$ = (0,1) indicator variable for Primary SIC codes 6000-6999 (financial services);
$b_{0,..,6}$ = the valuation coefficients.

All other variables are as defined in equation (1), above. When regressed, the variables in equation (2) are expressed in *per share* increments and deflated by the beginning of the period price to control for heteroskedasticity and size. Note that in this setting, b_2 reflects the valuation coefficient on earnings exclusive of the Y2K compliance costs, b_3 reflects the valuation coefficient on *current* Y2K compliance costs and b_4 reflects the valuation coefficient on estimated *future* Y2K compliance costs. $CY2K_{j,t}$ will be incrementally value relevant to the relevance of $NI^*_{j,t}$ only if the value relevance of current Y2K compliance costs differs from that of other earnings components within $NI_{j,t}$ ($b_2{}^1$ b_3).

From equation (2), we can formally state our first hypothesis, that on average, future costs relating to Y2K compliance are positively associated with firm valuation. We predict, therefore, that the coefficient on $FY2K_{j,t}$ in equation (2) will be positive. We formally state our hypothesis (in the alternative form), below.

H1: Estimated future Y2K-related expenditures will be positively value relevant ($b_4 > 0$).

To address our growth predictions, we modify equation (2) by partitioning the Y2K expenditures by a measure of growth. Specifically, firms with high (upper quartile) Price-to-Earnings (P/E) ratios are deemed to be high-growth, and represented by setting a dummy (0,1) indicator variable, *H*, to one. We also define growth using the Market-to-Book (M/B) ratio, as a test of the sensitivity of our results. We rank our variables using the inverse of the P/E and M/B (E/P and B/M ratios, respectively) to avoid small denominator effects.

We interact *H* with CY2Kj,t and $FY2K_{j,t}$ to test for differences in the valuation coefficients when growth is high. We also include *H* in the regression by itself, to control for other systematic differences between high-growth and low-growth firms (interacting all variables with H does not significantly alter our results). The resulting test model is presented below as equation (3).

$$PRICE_{j,t} = \gamma_0 + \gamma_1 H_{j,t} + \gamma_2 BV_{j,t} + \gamma_3 NI^*_{j,t} + \gamma_4 CY2K_{j,t} + \gamma_5 H * CY2K_{j,t} + \gamma_6 FY2K_{j,t} + \gamma_7 H * FY2K_{j,t} + \gamma_8 SIC4_{j,t} + \gamma_9 SIC6_{j,t} + \varepsilon_{j,t} \quad (3)$$

$g_{0,...,6}$ are the valuation coefficients and all variables are as defined in equations (1) and (2). From equation (3), we can formally state our second hypothesis. We predict that estimated future Y2K compliance costs are positively related to firm value to a greater extent for high-growth firms than for low or no-growth firms. Thus, we expect the coefficient on $FY2K_{j,t}$ interacted with the growth indicator variable, *H*, to be positive. This hypothesis is formally stated (in the alternative) below.

H2: The value relevance of estimated future Y2K-related expenditures will be stronger for companies identified as high-growth companies than for other companies (g_7 OL62\f"Symbol"\s12 0).

We make no formal predictions on the sign of g_5 since there is no basis to argue that early expenditures relating to Y2K will be more predictive of future earnings for either high-growth or low and no-growth firms. The next section discusses sample selection and presents descriptive statistics for our variables.

SAMPLE SELECTION AND DATA DEFINITIONS

We collected Y2K compliance costs from the fiscal year 1998 annual (10-K) reports filed by those firms included in the *Standard and Poors' 500* index. This population of firms was chosen not only because the index represents a cross section of the global economy, but also because firms are selected for the index based on size (large), and trading volume (high). These additional criteria provide us with controls for investor/analyst "attention," thus increasing the likelihood that the information in firms' Y2K disclosures was assessed by capital markets participants.

Y2K disclosure data was matched to data from *Compustat* to form our sample. Inclusion in the final sample required data on: current year-end and previous year-end market price of common stock, common equity total, common shares outstanding, income before extraordinary items and the factor to adjust for stock splits and stock dividends for 1998. One hundred of the S&P 500 firms were eliminated because they did not disclose an estimated dollar-amount for their Y2K compliance costs. Another 30 firms were excluded because of missing *Compustat* data. The final sample was winsorized to remove the effect of extreme values, and consists of 370 sample firms. The data set thus constructed, allows us to differentiate between Y2K costs-to-date and future expected costs.

Table 1 presents the industry distribution of our sample observations. The greatest sector representation in our sample comes from the Food/Textiles/Petroleum sector (23 percent) and the Leather/Minerals/Equipment sector (22 percent). Thirty-five percent of our sample consists of firms from SIC Codes within the 4000s and 6000s. This representation is consistent across our high-growth sub-samples, however, in our low-growth sub-samples the Banks/Insurance Carriers sector (SIC Codes within the 6000s) is either the largest or second largest group.

Table 1: Industry Distribution of Sample Observations

Industry	SIC Codes	Full Sample		High-Growth EP Sample		Low-Growth EP Sample		High-Growth BM Sample		Low-Growth BM Sample	
			% of		% of		% of		% of		% of
		Obs.	Sample	Obs.	Sample	Obs.	Sample	Obs.	Sample	Obs.	Sample
Agriculture / Forestry	0001-0999	1	0.27	0	0.00	1	0.36	1	1.09	0	0.00
Mining / Construction	1000-1999	14	3.78	5	5.43	9	3.24	2	2.17	12	4.32
Food / Textiles / Petroleum	2000-2999	85	22.97	28	30.43	57	20.50	36	39.13	49	17.63
Leather / Minerals / Equip	3000-3999	80	21.62	23	25.00	57	20.50	18	19.57	62	22.30
Transportation	4000-4999	61	16.49	10	10.87	51	18.35	6	6.52	55	19.78
Wholesale / Retail	5000-5999	38	10.27	9	9.78	29	10.43	10	10.87	28	10.07
Banks / Insurance Carriers	6000-6999	68	18.38	8	8.70	60	21.58	8	8.70	60	21.58
Automotive / Amusement	7000-7999	18	4.86	7	7.61	11	3.96	9	9.78	9	3.24
Health / Services	8000-8999	5	1.35	2	2.17	3	1.08	2	2.17	3	1.08
Other	9000-9999	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
Totals		370	100.00	92	100.00	278	100.00	92	100.00	278	100.00

Table 2, panel A presents descriptive statistics for our sample data. The mean (median) price per share is $48.20 ($43.19) with a minimum of $9.88 and a maximum of $118.56 (all U.S. dollars). Book values average $16.47 per share while net income averaged just over $2, with a range from a loss of $3.92 per share to income of 11.70 per share. The mean (median) return-on-equity for the sample is 16% (15%), and the mean (median) return-on-assets is 5% (4%). Mean total Y2K compliance costs are $0.29 per share with a range of $0.01 to $1.15. Current period Y2K compliance costs averaged $0.16 per share with a range of $0.00 to $1.09, while expected future Y2K expenses averaged $0.13 and ranged from $0.00 to $0.84 per share.

Table 2: Descriptive Statistics

Panel A: Full Sample (n=370)

Variable	Mean	Median	Std Dev	Min	Max
Market Price	48.20	43.19	23.93	9.88	118.56
Net Book Value	16.47	14.30	11.78	1.23	64.36
Earnings	2.14	2.05	2.31	-3.92	11.70
Total Assets	91.87	44.03	161.20	3.11	1491.76
Return-on-Equity	0.16	0.15	0.21	-1.62	1.74
Return-on-Assets	0.05	0.04	0.06	-0.13	0.46
Current Y2K Expenses	0.16	0.09	0.20	0.00	1.09
Expected Future Y2K Expenses	0.13	0.09	0.16	0.00	0.84
Total Expected Y2K Expenses	0.29	0.18	0.32	0.01	1.51

Table 2, panel B presents the descriptive statistics for the sample partitioned by growth, where growth is measured by the E/P ratio. Mean price, book value and net income are all greater for the high-growth E/P sub-sample than for the low-growth E/P sub-sample (all significant at the 0.001 level). Total assets, however, is significantly greater (at the 0.01 level) for the low-growth E/P sub-sample. None of the other descriptive measures differed between the sub-samples where growth is measured by the E/P ratio.

Table 2: Continued

Panel B: Sample partitioned by growth, where growth is measured by the E/P ratio

	High-Growth EP Sample (n=92)					Low-Growth EP Sample (n=278)					Difference in Means	
Variable	Mean	Median	Std Dev	Min	Max	Mean	Median	Std Dev	Min	Max		
Market Price	48.71	43.50	23.03	9.88	118.56	45.99	40.69	23.73	9.88	118.56	2.72	***
Net Book Value	17.51	15.61	10.97	1.23	64.36	12.61	9.69	9.57	1.23	53.79	4.90	***
Earnings	2.42	2.32	2.11	-3.92	11.70	1.25	1.15	1.86	-3.92	9.28	1.17	***
Total Assets	54.94	29.20	105.1	6.16	928.56	104.1	52.71	174.3	3.11	1491.8	-49.2	***
Return-on-Equity	0.15	0.13	0.32	-1.62	1.74	0.16	0.16	0.15	-0.59	0.90	-0.02	
Return-on-Assets	0.05	0.04	0.07	-0.13	0.46	0.05	0.04	0.05	-0.12	0.24	0.00	
Current Y2K Expenses	0.17	0.10	0.21	0.00	1.09	0.12	0.07	0.16	0.00	1.09	0.06	
Expected Future Y2K Expenses	0.13	0.09	0.14	0.00	1.51	0.13	0.08	0.17	0.00	0.90	0.00	
Total Expected Y2K Expenses	0.31	0.21	0.32	0.00	2.04	0.24	0.15	0.29	0.01	1.45	0.06	

Notes: *, **, *** indicate significance at the ten, five and one percent level, respectively for a two-tailed *p*-value.

Table 2, panel C presents the descriptive statistics for the sample partitioned by growth, where growth is measured by the B/M ratio. Mean price is again greater for the high-growth sub-sample than for the low/no-growth sub-sample, as are return-on-equity and return-on-assets (significant at the 0.01, 0.01 and 0.05 levels respectively). Book value, net income and total assets, however, are significantly greater (at the 0.01 level) for the low-growth B/M sub-sample, as is total expected Y2K costs (significant at the 0.01 level). Neither current, nor future Y2K costs, however, differed between the sub-samples where growth is measured by the B/M ratio.

Table 2: Continued

Panel C: Sample partitioned by growth, where growth is measured by the B/M ratio

	High-Growth BM Sample (n=92)					Low-Growth BM Sample (n=278)					Difference in Means	
Variable	Mean	Med-ian	Std Dev	Min	Max	Mean	Med-ian	Std Dev	Min	Max		
Market Price	56.68	54.75	25.43	10.06	118.56	45.17	41.22	21.72	9.88	118.56	11.51	***
Net Book Value	7.04	6.70	3.64	1.23	15.84	19.36	17.00	10.68	3.23	64.36	-12.32	***
Earnings	1.81	1.76	1.14	-2.14	6.51	2.23	2.21	2.33	-3.92	11.70	-0.42	***
Total Assets	27.31	21.73	28.00	3.11	226.71	113.2	56.40	180.32	6.90	1491.8	-85.93	***
Return- on-Equity	0.29	0.26	0.32	-1.62	1.74	0.12	0.13	0.13	-0.59	0.92	0.18	***
Return- on-Assets	0.09	0.09	0.06	-0.06	0.24	0.04	0.03	0.05	-0.13	0.46	0.06	**
Current Y2K Expenses	0.10	0.06	0.13	0.00	1.03	0.18	0.11	0.21	0.00	1.09	-0.08	
Expected Future Y2K Expenses	0.09	0.06	0.12	0.00	0.90	0.14	0.10	0.16	0.00	1.51	-0.05	
Total Expected Y2K Expenses	0.19	0.11	0.23	0.00	1.43	0.32	0.22	0.33	0.00	2.04	-0.13	**

Notes: *, **, *** indicate significance at the ten, five and one percent level, respectively for a two-tailed p-value.

Table 3 presents the pairwise correlation matrix for our model variables. Panel A presents these correlations for the full sample. As expected, net income is highly correlated with market value (0.146, p = 0.0048), but neither current nor total Y2K related expenditures are (-0.007, p = 0.8959 and 0.040, p = 0.4418, respectively). Future Y2K expenditures are, however, significantly correlated with price, as they are with book value, income and current period Y2K expense (p-values of 0.0806, 0.0001, 0.0337 and 0.0001 respectively). Similarly, both current period Y2K expense and total Y2K related expenditures are significantly correlated with book value and income (all p values < 0.0002).

The strong correlations with net book value suggest that size is an important factor in determining future Y2K related expenditures (i.e., if a firm has a great deal of equipment, the firm will need to engage in a great deal of Y2K remediation). The relationship between current and future Y2K related expenses and size emphasizes the need to control for size in any test of value relevance.

These correlations support the need to use a valuation model that incorporates net book value as a regressor to control for size.

Table 3: Correlation Matrix						
Panel A: Full Sample (n=370)						
	PRICE	BV	NI*	CY2K	FY2K	TY2K
PRICE	**1.000**					
BV	**0.016**	**1.000**				
	0.7531					
NI*	**0.146**	**-0.001**	**1.000**			
	0.0048	0.9826				
CY2K	**-0.007**	**0.186**	**0.218**	**1.000**		
	0.8959	0.0003	0.0001	0.0947		
FY2K	**0.091**	**0.303**	**0.110**	**0.595**	**1.000**	
	0.0806	0.0001	0.0337	0.0001		
TY2K	**0.040**	**0.265**	**0.191**	**0.920**	**0.862**	**1.000**
	0.4418	0.0001	0.0002	0.0001	0.0001	

Of particular interest is the strong correlation between current and future Y2K related expenditures (0.595, p = 0.0001). Since the focus of this study is on the relevance of the supplemental Y2K disclosures, this strong correlation suggests that Y2K related expenditures that are already accrued in earnings might be sufficient to proxy for *all* Y2K related expenditures (and earnings). Likewise, the strong correlation also reinforces the need to test the relevance of estimated future Y2K related expenditures as a test of *incremental* value relevance to current Y2K expenditures. Only a joint test of both current and future Y2K related expenditures would address whether the supplemental disclosures regarding Y2K are value relevant.

Panel B of Table 3 presents the pairwise correlation matrix for our model variables partitioned by our growth measures. The correlations for the high-growth sub-sample, where growth is measured by the E/P ratio, are qualitatively identical to those of the full sample. Of notable difference to the low-growth E/P sub-sample, is the strong correlation between future Y2K expenditures and net income (0.201, p = 0.0007 and -0.040, p = 0.7031, for the high- and low-growth E/P sub-samples respectively).

For the sub-samples where growth is measured by the B/M ratio (Panel C), however, this relationship is reversed. Future Y2K expenditures are not correlated with net income for the high-growth B/M sub-sample (0.089, p = 0.1391), yet they are for the low-growth B/M sub-sample (0.210, p = 0.0444). As noted above for the full sample, in each sub-sample current and future Y2K expenditures are highly correlated (all significant at the 0.0001 level). The differences noted across the E/P and B/M partitions may not be surprising, since the net assets-in-place (net book value) likely influence the level of the Y2K investment.

Table 3: Continued

Panel B: Sample partitioned by growth, where growth is measured by the E/P ratio

	High-Growth EP Sample (n=92)						Low-Growth EP Sample (n=278)					
	PRICE	BV	NI*	CY2K	FY2K	TY2K	PRICE	BV	NI*	CY2K	FY2K	TY2K
PRICE	**1.000**						**1.000**					
BV	**-0.012**	**1.000**					**0.126**	**1.000**				
	0.8375						0.2315					
NI*	**0.190**	**0.064**	**1.000**				**0.160**	**-0.267**	**1.000**			
	0.0014	0.2862					0.1283	0.0101				
CY2K	**-0.015**	**0.184**	**0.208**	**1.000**			**0.080**	**0.164**	**0.179**	**1.000**		
	0.8083	0.0020	0.0005	0.0947			0.4470	0.1178	0.0881	0.0947		
FY2K	**0.087**	**0.318**	**0.201**	**0.611**	**1.000**		**0.089**	**0.292**	**-0.040**	**0.676**	**1.000**	
	0.1481	0.0001	0.0007	0.0001			0.3975	0.0048	0.7031	0.0001		
TY2K	**0.029**	**0.264**	**0.227**	**0.937**	**0.850**	**1.000**	**0.093**	**0.258**	**0.060**	**0.892**	**0.937**	**1.000**
	0.6330	0.0001	0.0001	0.0001	0.0001		0.3776	0.0132	0.5678	0.0001	0.0001	

Table 3: Continued

Panel C: Sample partitioned by growth, where growth is measured by the B/M ratio

	High-Growth BM Sample (n=92)						Low-Growth BM Sample (n=278)					
	PRICE	BV	NI*	CY2K	FY2K	TY2K	PRICE	BV	NI*	CY2K	FY2K	TY2K
PRICE	**1.000**						**1.000**					
BV	**0.110**	**1.000**					**0.138**	**1.000**				
	0.0660						0.1899					
NI*	**0.144**	**-0.064**	**1.000**				**0.283**	**0.300**	**1.000**			
	0.0162	0.2879					0.0063	0.0037				
CY2K	**-0.001**	**0.131**	**0.210**	**1.000**			**0.046**	**-0.071**	**0.270**	**1.000**		
	0.9916	0.0290	0.0004	0.0947			0.6607	0.4985	0.0092	0.0947		
FY2K	**0.174**	**0.277**	**0.089**	**0.546**	**1.000**		**-0.056**	**0.017**	**0.210**	**0.725**	**1.000**	
	0.0036	0.0001	0.1391	0.0001			0.5947	0.8756	0.0444	0.0001		
TY2K	**0.089**	**0.224**	**0.177**	**0.903**	**0.853**	**1.000**	**0.007**	**-0.040**	**0.265**	**0.959**	**0.891**	**1.000**
	0.1395	0.0002	0.0031	0.0001	0.0001		0.9448	0.7034	0.0107	0.0001	0.0001	

Notes: The table reports the Pearson correlation coefficients and associated *p*-values for our model variables.

EMPIRICAL RESULTS

Pooled Results

Table 4 presents our initial regression results. The first model presented is our base model in which we regress equation (2) without the Y2K variables. This model serves as a basis of comparison to our test regressions. Note that net income in the base model includes current Y2K related expenditures as an expense. In our test regressions, however, net income will exclude current Y2K related expenditures when these expenditures are regressed as separate regressors (the third regression in tables 4 and 5) and include current Y2K related expenditures when these expenditures are not regressed as a separate regressor (the first and second regressions of tables 4 and 5).

Table 4: Regression Results - No Interactions for Growth

$$PRICE_{j,t} = \beta_0 + \beta_1 \boldsymbol{BV} + \beta_2 \boldsymbol{NI^*}_{j,t} + \beta_3 \boldsymbol{CY2K}_{j,t} + \beta_4 \boldsymbol{FY2K}_{j,t} + \beta_5 \boldsymbol{SIC4}_{j,t} + \beta_6 \boldsymbol{SIC6}_{j,t} + \epsilon_{j,t}$$

	Adj. R^2	Intercept	BV	NI*	CY2K	FY2K#	SIC4	SIC6
Expected sign		?	+	+	?	+	?	?
Base Model	**0.7270**	**30.054**	**1.201**	**5.761**			**-52.813**	**14.346**
		(0.0224)	(0.0001)	(0.0001)			(0.0521)	(0.7923)
FY2K Model	**0.7320**	**24.132**	**1.073**	**5.371**		**25.272**	**-46.583**	**36.224**
		(0.0675)	(0.0001)	(0.0001)		(0.0027)	(0.0847)	(0.5067)
Joint Model	**0.7320**	**27.947**	**1.067**	**5.518**	**-8.744**	**31.424**	**-48.975**	**38.446**
		(0.0418)	(0.0001)	(0.0001)	(0.3100)	(0.0021)	(0.0710)	(0.4813)

Notes:

$PRICE_{j,t}$ = the market value per share of firm *j*'s stock at time *t*;
$BV_{j,t}$ = net book value per share of firm *j*'s equity at time *t*;
$NI^*_{j,t}$ = firm *j*'s current earnings per share prior to extra-ordinary items from time *t-1* to *t* in the first and third regressions, and firm *j*'s current earnings per share prior to extraordinary items from time *t-1* to *t* in the first and third regressions, sans current period Y2K costs ($CY2K_{j,t}$) in the second and fourth regressions;
$CY2K_{j,t}$ = firm *j*'s current Y2K compliance costs recognized in earnings from time *t-1* to *t*;
$FY2K_{j,t}$ = firm *j*'s disclosed expectation, at time *t*, of future Y2K compliance costs;
$SIC4_{j,t}$ = (0,1) indicator variable for Primary SIC codes 4000-4999 (transportation and utilities);
$SIC6_{j,t}$ = (0,1) indicator variable for Primary SIC codes 6000-6999 (financial services);
$\beta_{0,\ldots,6}$ = the valuation coefficients.

The table presents the regression coefficients and their associated *p*-values. All tests are two-tailed, except were indicated by # they are one-tailed.

The second regression tests the relevance of future Y2K related expenditures without separately including current Y2K related expenses. In this regression the coefficient on $FY2K_{j,t}$ is, as expected, positive and significant (25.272, $p = 0.0027$). An F-test comparing the coefficients on $NI_{j,t}$ and $FY2K_{j,t}$ indicate that future Y2K expenditures are incrementally value relevant to the relevance of aggregate earnings ($p = 0.0310$).

The final regression includes CY2Kj,t and $FY2K_{j,t}$ as separate regressors. The coefficient on $CY2K_{j,t}$ is negative, but not significant (-8.744, $p = 0.3100$), indicating that the current period Y2K expense is not incrementally value relevant to the information already contained in earnings about Y2K related expenditures. Consistent with this result, the F-test comparing the coefficients on $CY2K_{j,t}$ and $NI^{*}_{j,t}$ indicates that no significant difference exists between these coefficients ($p = 0.1046$). The coefficient on $FY2K_{j,t}$ is, however, still positive and significant (31.424, $p = 0.0021$), providing evidence that the supplemental disclosures of estimated future Y2K related expenditures are incrementally value relevant to other accounting disclosures. Additionally, the coefficient on $FY2K_{j,t}$ is significantly different from the coefficient on $NI_{j,t}$ ($p = 0.0183$). As expected, the coefficients on $FY2K_{j,t}$ and $CY2K_{j,t}$ are significantly different from each other ($p = 0.0202$).

Tests of Differences

Table 5 presents the regression results that test for differences in the value relevance of Y2K disclosures between high-growth firms and low/no firms. As above, three regressions are presented. Again, the first is the base model to serve as a basis for comparison. The second regresses future Y2K related expenditures, but does not partition earnings. The final regression regresses both current and future Y2K related expenditures as separate regressors.

Table 5: Regression Results - Interaction for Growth

$$PRICE_{j,t} = \gamma_0 + \gamma_1 \mathbf{H}_{j,t} + \gamma_2 \mathbf{BV} + \gamma_3 \mathbf{NI^*}_{j,t} + \gamma_4 \mathbf{CY2K}_{j,t} + \gamma_5 \mathbf{H^*CY2K}_{j,t} + \gamma_6 \mathbf{FY2K}_{j,t} + \gamma_7 \mathbf{H^*FY2K}_{j,t} + \gamma_8 \mathbf{SIC4}_{j,t} + \gamma_9 \mathbf{SIC6}_{j,t} + \epsilon_{j,t}$$

Panel A: Growth firms defined as those ranked in the lower 25-percentile of sample firms' E/P ratios.

	Adj. R^2	Intercept	High	BV	NI*	CY2K	H*CY2K	FY2K#	H*FY2K#	SIC4	SIC6
Expected sign		?	?	+	+	?	?	+	+	?	?
Base Model	0.7391	10.429	96.735	1.153	6.072					-34.275	21.959
		(0.4444)	(0.0001)	(0.0001)	(0.0001)					(0.2026)	(0.6803)
FY2K Model	0.7511	15.779	47.601	1.009	5.858			-2.798	59.750	-26.740	30.815
		(0.2485)	(0.0619)	(0.0001)	(0.0001)			(0.8006)	(0.0002)	(0.3099)	(0.5583)
Joint Model	0.7504	17.464	42.772	1.008	5.793	-1.760	22.888	-0.635	45.126	-26.934	32.316
		(0.2306)	(0.1042)	(0.0001)	(0.0001)	(0.8464)	(0.3393)	(0.9624)	(0.0238)	(0.3110)	(0.5405)

Panel A presents our results when growth is measured with the E/P ratio. The results indicate that when regressed separately (model three), $FY2K_{j,t}$ is not value relevant for low/no-growth firms (-2.798, $p = 0.8006$). Similarly, when regressed jointly, neither $CY2K_{j,t}$ nor $FY2K_{j,t}$ are significant for low/no-growth firms (-1.760, $p = 0.8464$ and –0.635, $p = 0.9624$ respectively). This indicates that for low/no-growth firms, the information accrued in earnings regarding Y2K related expenditures is sufficient, from a valuation perspective. The supplemental disclosures that estimate future Y2K related expenditures for low/no-growth firms are, therefore, not value relevant.

The results from interacting *H* with $FY2K_{j,t}$, and *H* with $CY2K_{j,t}$ and $FY2K_{j,t}$ (models two and three), however, indicate that the value relevance of the supplemental disclosures that estimate future Y2K related expenditures are significantly greater for high-growth firms than for low-growth firms. The coefficient on $H*FY2K_{j,t}$ is 59.750 (p = 0.0002). When regressed jointly, the coefficient on $H*FY2K_{j,t}$ still significant (45.126, p = 0.0238), and the coefficient on $H*CY2K_{j,t}$ is not (22.888, p = 0.3393). This indicates that the supplemental disclosures that estimate future Y2K related expenditures are incrementally value relevant to other accounting disclosures for high-growth firms and that the disclosure of current period Y2K expense is not incrementally valuation relevant beyond the information contained in earnings.

Panel B of Table 5 presents our results when growth is measured with the B/M ratio. The results, while substantially identical to those presented in panel A, do reveal a notable difference. When growth is measured by the B/M ratio in the joint regression, both the coefficient on $H*FY2K_{j,t}$ and the coefficient on $FY2K_{j,t}$ are positive and significantly different from zero (59.252, p = 0.016 and 18.921, p = 0.045 respectively). The coefficient on $FY2K_{j,t}$ for low/no-growth firms, however, is not significantly different from $NI_{j,t}$. (p = 0.2112), while the coefficient on $FY2K_{j,t}$ for high-growth firms is (p = 0.0049). This strengthens the support for our conclusion that the supplemental disclosures that estimate future Y2K related expenditures are incrementally value relevant to other accounting disclosures, and indicates that those disclosures are more relevant for high than for low or no-growth firms.

Table 5: Continued

Panel B: Growth firms defined as those ranked in the lower 25-percentile of sample firms' B/M ratios.

	Adj. R^2	Intercept	High	BV	NI*	CY2K	H*CY2K	FY2K#	H*FY2K#	SIC4	SIC6
Expected sign		?	?	+	+	?	?	+	+	?	?
Base Model	0.7530	-1.145	184.766	1.364	5.077					-39.295	-4.345
		(0.9320)	(0.0001)	(0.0001)	(0.0001)					(0.1296)	(0.9333)
FY2K Model	0.7567	-0.966	133.464	1.301	4.812			10.226	42.202	-36.935	9.683
		(0.9428)	(0.0003)	(0.0001)	(0.0001)			(0.1380)	(0.0262)	(0.1522)	(0.8527)
Joint Model	0.7585	3.905	161.810	1.296	4.992	-12.308	-22.417	18.921	59.252	-40.121	9.906
		(0.7763)	(0.0001)	(0.0001)	(0.0001)	(0.1745)	(0.3268)	(0.0445)	(0.0163)	(0.1199)	(0.8490)

Notes:

$PRICE_{j,t}$	=	the market value per share of firm *j*'s stock at time *t*;
$H_{j,t}$	=	(0,1) indicator variable for low (high) growth, where growth is measured by the earnings-to-price ratio (panel A) and book-to-market ratio (panel B), and *high* growth is defined as ranking in the lower quartile of firms for that ratio;
$BV_{j,t}$	=	net book value per share of firm *j*'s equity at time *t*;
$NI^{*}_{j,t}$	=	firm *j*'s current earnings per share prior to extraordinary items from time *t-1* to *t* in the first and third regressions, and firm *j*'s current earnings per share prior to extra-ordinary items from time *t-1* to *t* in the first and third regressions, sans current period Y2K costs $CY2K_{j,t}$) in the second and fourth regressions;
$CY2K_{j,t}$	=	firm *j*'s current Y2K compliance costs recognized in earnings from time *t-1* to *t*;
$FY2K_{j,t}$	=	firm *j*'s disclosed expectation, at time *t*, of future Y2K compliance costs;
$H*CY2K_{j,t}$	=	firm *j*'s current Y2K compliance costs recognized in earnings from time *t-1* to *t*, interacted with a (0,1) indicator variable for low (high) growth, where growth is measured by the earnings-to-price ratio (panel A) and book-to-market ratio (panel B), and *high* growth is defined as ranking in the lower quartile of firms for that ratio;
$H*FY2K_{j,t}$	=	firm *j*'s disclosed expectation, at time *t*, of future Y2K compliance costs, interacted with a (0,1) indicator variable for low (high) growth, where growth is measured by the earnings-to-price ratio (panel A) and book-to-market ratio (panel B), and *high* growth is defined as ranking in the lower quartile of firms for that ratio;
$SIC4_{j,t}$	=	(0,1) indicator variable for Primary SIC codes 4000-4999 (transportation and utilities);
$SIC6_{j,}$	=	(0,1) indicator variable for Primary SIC codes 6000-6999 (financial services);
$g_{0,...,9}$	=	the valuation coefficients.

The table presents the regression coefficients and their associated *p*-values. All tests are two-tailed, except were indicated by # they are one-tailed.

CONCLUSIONS

The results reported above support our hypotheses by indicating that disclosures of estimated future IT investments are value relevant (H_1). We find additional evidence that estimated future IT costs are more relevant (perhaps solely relevant) for high-growth firms (H_2). For other firms, the relevance of earnings subsumes any additional benefits contained in the supplemental disclosures.

These results are noteworthy for several reasons. First, our findings suggest that although the disclosure of expected *future* IT costs is relevant for current period valuation, the relevance of those disclosures may be conditional on expectations regarding future operational success (i.e., growth). Second, by showing that the value relevance of estimated cost disclosures are conditional on future growth, our findings may provide an explanation for the seemingly contradictory results of prior research that has attempted to determine the value relevance of investments in information technology.

While it is, of course, possible that our results are coincidental to, rather than caused by, IT expenditures (i.e., Y2k may not be a good surrogate for general IT investment) we see no evidence to support this conjecture. Rather, we conclude from these results and from the body of research related to IT investment, that the disclosure of IT investment is indeed relevant to investors in assessing the future operations of publicly traded firms. Further, our evidence supports the notion that investments in information technology are positively associated with returns. This value relevance exceeds the association between returns and other assets, however, only for high-growth firms. This investment/growth relationship may be of significant consequence to IT managers, and should be considered in evaluating the type and extent of future investments in IT within a strategic, value-enhancing context.

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ON THE FINANCIAL CHARACTERISTICS OF FIRMS THAT EXPERIENCED THE HIGHEST LEVELS OF STOCK PRICE STABILITY IN A PERIOD OF ECONOMIC RECESSION

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ABSTRACT

Stock price instability or volatility is a measure of risk in holding common stocks, and indeed, it is the basic element in the calculation of Sharpe's beta. Value Line publishes weekly, a ranking of stock price stability for every firm in their database. The higher the Value Line ranking for price stability, the more likely they would recommend it as a safe investment. Prior work on this subject has considered to some degree the underlying macroeconomic environment, but there have been no studies that measured the financial characteristics of those firms that achieved the highest Value Line ratings for price stability in a period of economic recession.

Our analysis tests for significant differences in the financial profiles of those firms that achieved the highest Value Line ratings for price stability in a period of economic recession and companies selected at random during the same period, and from the same industries. A unique financial profile is established for the highest rated group, and it is suggested that the profile may be used to predict firms that may achieve high levels of stock price stability in the event of future economic downturns.

INTRODUCTION

The price level stability of common stocks is considered an important factor in the safety of equity investments. Indeed, the lack of stability, or a high measure of volatility is the basic element in Sharpe's beta, a familiar tool used to measure the systematic (relevant) risk in a portfolio. Safety of investment has been of interest to investors, investment counselors, financial managers, and academicians for many years, and in periods of economic recession it becomes of paramount importance.

The period from March 2001 to November 2001 was identified by the National Bureau of Economic Research's Business Cycle Dating Committee, as a period of economic recession in the United States (Associated Press, 2003). However, the downturn in the economy had started much earlier. On Jan. 14, 2000, the Dow-Jones Industrial Average closed at 11,722.98. That was an all-time high, but over the next two years, the Dow lost 38.7% of its value as it fell to a low of 7,286 on October 9th 2002 (Dow-Jones, 2006). The summer of the year 2000 was characterized by a great deal of political activity. It was a presidential election year and the race was apparently going to be very close. Thus, too little notice was given to such announcements as J. C. Penny declaring their intentions to close many of their stores, including stores in their Eckerd's chain, that were just marginally profitable. The action of Penny's and other firms was to result in many layoffs in the retail industry (Payne & Daghestani, 2000). During the next two years savings and retirement funds were significantly diminished, and unemployment increased to 6.3 percent in June 2003 when 9,338,000 persons were unemployed, (U.S. Department of Labor, February 2004). The decline in business activity, and rising unemployment were not only the result of the recession. The holocaust that has become known as nine-eleven, and the disclosures of corporate scandals also contributed to the downturn. (Payne & Wong, 2004). Thus, the period from March to October 2001 provides a "workshop" to study the financial characteristics of firms during an economic recession.

It would be a gross understatement to say that in the period of roughly two years, described above, when the Dow-Jones Industrial average lost 38.7 percent of its value, all parties whether they were investors, sellers, financial counselors, or financial managers considered the measure of the price stability of common stocks to be of a measure of primary importance. However, the subject of stock price stability has been the topic of very little research. Most previous studies have collected data from time periods of relative market stability or periods of growth such as the decade of the 1990's. For example see: (Gittens, 2006; Shen & Shen, 2006; Business Week, July 3, 2006). Payne and Daghestani (1998) studied the financial determinants of safety during a period of great optimism, expectations of future growth, and a general feeling among investors that the market could only go up. They concluded on the basis of their analysis, that the firms characterized by safety of investment during this period had in their financial profile a greater level of capital spending, a greater return to total capital, less financial leverage, and surprisingly, less growth potential than a randomly selected group of similar firms. Three of those explanatory variables are also present in this study, and therefore may be compared in the conclusions presented in this analysis. There have been no studies that have considered financial variables that are consistent with stock price stability during economic downturns and recessions.

The purpose of this study is to establish a financial profile of firms identified by Value Line as having the highest levels of stock price stability in their database during the abovementioned period of economic recession, and to determine whether these firms have financial profiles that are significantly different from firms selected at random. If such a profile is established, and it can be validated without bias, it is suggested that it may be used to predict firms that will maintain the highest levels of stock price stability in periods of future economic downturns. This would have implications for financial managers, investors, investment counselors, and indeed, the entire market, and business community.

METHODOLOGY

The issues to be resolved are first, classification or prediction, and then evaluation of the accuracy of that classification. More specifically, can firms be assigned, on the basis of selected variables, to one of two groups: (1) firms chosen by Value Line for their number one rating for stock price stability (VLSPS),1 or (2) firms chosen randomly, but from the same industries as the first group (RCF)? Multiple discriminant analysis (MDA) provides a procedure for assigning firms to predetermined groupings based on variables or attributes whose values may depend on the group to which the firm actually belongs.

If the purpose of the study were simply to establish a financial profile of each group of firms, simple ratios would be adequate. In an early seminal paper on the use of MDA in finance, Altman (1968) showed that sets of variables used in multivariate analysis were better descriptors of the firms, and had more predictive power than individual variables used in univariate tests.

The use of MDA in the social sciences for the purpose of classification is well known. MDA is appropriate when the dependent variables are categorically measured and the predictive variables are measured metrically. In addition to its use in the Altman study to predict corporate bankruptcy, other early studies used MDA to, predict financially distressed property-liability insurance firms (Trieschmann & Pinches, 1973), growth (Payne, 1993), and the failure of small businesses (Edmister, 1982). This study also employs categorically measured dependent variables and metrically measured predictive variables. The two categorically measured dependent variables are the group of VLSPS firms and the group of RCF firms. The computer program used to perform the analysis is SPSS 11.5.0 Discriminant Analysis (SPSS Inc., 2002).

Since the objective of the analysis is to determine the discriminating capabilities of the entire set of variables without regard to the impact of individual variables, all variables were entered into the model simultaneously. This method is appropriate since the purpose of the study is not to identify the predictive power of any one variable, but instead the predictive power of the entire set of independent variables (Hair et al., 1998, p. 208-209).

SELECTION OF SAMPLE AND INDEPENDENT VARIABLES

All data used in the analysis were gathered from Value Line Ratings and Reports. Value Line ranks every firm in its database on a scale of 100 to 5 for stock price stability, where stocks with a ranking of 100 have the greatest stability and stock ranked 5 have the least stability. The sample selected for this study consists of two groups of 100 firms. The first group was identified by Value Line as having the highest ratings in our sample. The second group is a group of 100 firms randomly selected from the Value Line database, but from the same industries as the first group.

In periods of decline and recession all industries will not experience the same adverse effects. It follows that for an unbiased study the effects of industry must be held constant. In a seminal article on the assessment of risk, Hinich and Roll (1975) wrote that industries (or portfolios) will average out by cross section events peculiar to individual companies (or securities). In addition, Blume, (1971) wrote that even a large magnitude of individual variance may make the model inadequate for valuing an individual firm, but that it is adequate in cross section analysis.

The cross sectioning elimination of industry bias in this study was accomplished by matching the companies in the VLSPS group with companies from the same industry in the RCF group. For example from the drug industry, Pfizer is in the VLSPS group, and Biovail is in the RCF group. From the oilfield services industry, Transocean Incorporated is in the VLSPS group and Rowarn Companies is in the RCF group. From the medical supplies industry, Boston Scientific is in the VLSPS group and Priority Health is in the RCF group. O'Charlie's is in the VLSPS group from the restaurant industry, and P.F. Chang's is in the RCF group. In this manner each company identified by Value Line as having high ratings for stock price stability was matched with a randomly chosen company, from the same industry. Thus, the matching method of randomly choosing, and matching companies from the same industries eliminates any bias due to differences in industry listings. Previous studies using this and other statistical methods have chosen explanatory variables by various methods and logical arguments. In this study the group of explanatory variables chosen for analysis includes a measure of return to all investors, a measure of the market's perception of the firms potential, two measures of risk, a measure of investment safety, a measure of investment timeliness, and finally a measure of earnings predictability. An evaluation of these measures is needed to accomplish the purpose of this study.

The measure of return is return to total capital. Return to total capital includes a return to creditors as well as owners, and recognizes that value is affected by the cost of debt. A measure of return to equity could be used, but it would ignore the cost of debt and the fact that debt as well as equity finance the assets owned by the firm.

The ratio of market price to earnings (P/E) has been used for years as a rough measure of how the market values a firm. Indeed, the P/E multiple, and dividend yield are the only ratios reported every day on the financial pages of newspapers, and it has been argued that in efficient markets the multiple reflects the intrinsic value of the stocks, (Scripto, 1998; Payne & Tyler, 2002). More recently, the price earnings growth ratio (PEG) has grown in popularity. The price earnings growth multiple adjusts the P/E ratio for potential growth, and it is suggested that the price earnings multiple (P/E) used without the adjustment for growth has a high potential for undervaluing a company. Damodaran, (2002) writes that the PEG ratio is a better measure of a company's potential future value, and was developed to address the shortcomings of the P/E multiple. He further writes that many analysts have abandoned the P/E ratio, not because of any perceived shortcomings, but simply because they desire more information about a stock's potential. Thus, the use of the PEG ratio is used here as a measure of a company's potential long term value to investors.

Sharpe's beta coefficients contain the effects of both operating and financial leverage. It is felt that the VLSPS firms may have less of both types of risk than the RCF. This may not be the case however, and separate measures of financial and operating risk will identify any differences. The separation is accomplished by "unlevering" published betas using the well known Hamada (1972) equation designed for that purpose. The unlevered beta is a measure of operating risk, and the debt to total capital ratio as the measure of financial risk, or financial leverage. (Van Horne, 2001, p. 207). Hamada's equation requires a tax rate for each firm in the sample. These rates are published in Value Line Ratings and Reports for every firm in their database.

The ratio of long-term debt to total capital is used as the measure of financial risk. There are other ratios that measure financial risk very well, but the long-term debt to total capital ratio recognizes that the firm is financed by creditors as well as owners.

When entering into a period of economic recession and declining market values investors may value the safety of investment factor more than it would be valued in more normal capital markets. Even in periods of slow economic recovery such as the years 2001 to 2004, where investors, have just emerged from a period of economic recession, safety of investment may be of primary concern. Value Line ranks all firms in their database on the basis of safety of investment from one to five where number one is the safest ranking and number five is the worst. Accordingly, the Value Line ranking system is used here for the purpose of measuring safety of investment.

The measure of the timeliness of investing in a particular firm is Value Line's proprietary timeliness rating. It is their ranking of a stock's probable relative market performance in the year ahead. It is derived by Value Line via a computer program using as input the long-term price and earnings history, recent price and earnings momentum, and earnings surprise. All data are known and actual. Stocks ranked 1 (Highest) and 2 (Above Average) are likely to outpace the year-ahead market. Those ranked 4 (Below Average) and 5 (Lowest) are expected to under perform most stocks over the next 12 months. Stocks ranked 3 (Average) may advance or decline with the market in the year ahead. For four decades, Value Line's Timeliness Ranking System has accurately anticipated stocks' subsequent relative price performance (http://www.valueline.com/whyusehow). It is expected that stocks identified as high levels of price stability would also have a high timeliness ranking.

Whereas the value of any firm may ultimately depend on its ability to generate earnings and positive cash flows, the predictability of those earnings would seem to be a primary concern to potential investors, particularly in a period or economic recession. Thus, a measure is needed for earnings predictability. The Value Line measure of earnings predictability is a measure of the reliability of an earnings forecast. According to Value Line, predictability is based upon the stability of year-to-year comparisons, with recent years being weighted more heavily than earlier years. The most reliable forecasts are those with the highest rating (100); the least reliable, are those with the lowest rating (5). Value Line's earnings predictability is derived from the standard deviation of percentage changes in quarterly earnings over an eight-year period. Special adjustments are made for comparisons around zero and from plus to minus (Value Line, 2006).

A basic tenet of this study is that investors at the margin evaluate the degree of risk in an investment and compare it to the investment's potential rate of return. In modern finance textbooks this is a fundamental principle referred to as the "risk-return tradeoff." (Van Horne, 2001) Investors at the margin "trade off" proxies for risk and return in buying and selling securities to establish demand and thus, price or market value. Stock price stability is simply one side of that tradeoff, but when investors become more risk averse, as in the period under study, they have to realize a greater potential return to assume marginal risks.

In sum, there are seven explanatory variables in the multiple discriminant model. They are as follows:

X1 - The Return on Total Capital
X2 - The Price Earnings Growth Ratio
X3 - Long Term Debt to Total Capital
X4 - Operating Leverage-Unlevered Beta
X5 - The Value Line Safety Rating
X6 - The Value Line Timeliness Rating
X7 - Earnings Predictability

The explanatory variable profile contains basic measures of common financial variables. They were chosen, as in any experimental design, because of their consistency with theory, adequacy in measurement, the extent to which they have been used in previous studies and their availability from a reputable source.

TESTS AND RESULTS

The discriminant function used has the form:

$$Zj = V1X1j+V2X2j+\ldots+VnXnj \qquad \text{Formula (1)}$$

where:

Xij is the firm's value for the ith independent variable.
Vi is the discriminant coefficient for the firm's jith variable.
Zj is the jth individual's discriminant score.

The function derived from the data in this study and substituted in equation 1 is:

$$Zj = -2.97 - 1.266X1 + .033X2 - 1.491X3 + .901X4 + .637X5 + .130X6 - .012X7 \qquad \text{Formula (2)}$$

Classification of firms is relatively simple. The values of the six variables for each firm are substituted into equation (2). Thus, each firm in both groups receives a Z score. If a firm's Z score is more than the cutoff (critical) the firm is classified in group one (VLSPS). Conversely, a Z score less than the cutoff value will place the firm in group two (RCF). When group sizes are equal, as is the case in this study, the cutoff is the mean of the two group centroids (Garison, 2007). The group centroid for the RCF group is .790 and the group centroid for the VLSPS group is -.790. Thus, the cutoff rate in this study is zero. Since the two groups are heterogeneous, the expectation is that VLSPS firms will fall into one group and the RCF firms will fall into the other.

Interpretation of the results of discriminant analysis is usually accomplished by addressing four basic questions:

1. Is there a significant difference between the mean vectors of explanatory variables for the two groups of firms?
2. How well did the discriminant function perform?
3. How well did the independent variables perform?
4. Will this function discriminate as well on any random sample of firms as it did on the original sample?

To answer the first question, SPSS provides a Wilk's Lamda – Chi Square transformation (Cooper and Schindler, 2001, p.581). The calculated value of Chi-Square is 95.12. That exceeds the critical value of Chi-Square of 14.07 at the five percent level of significance, with 7 degrees of freedom. The null hypothesis that there is no significant difference between the financial profiles of the two groups is therefore rejected, and the first conclusion drawn from the analysis is that the two groups have significantly different financial characteristics. This result was of course, expected since one group of firms was ranked number one for stock price stability and the other was chosen randomly. Further evidence of the strength of the Wilk's Lamda – Chi Square transformation is given by the Eigenvalue in the SPSS output. The strength of the relationship between the pairs of variates is given by the canonical correlations. The Eigenvalues are simply the squared canonical correlations, and are sometimes referred to as the canonical roots (Hair et al, 1998, p.450). The closer the Eigenvalue is to the integer one, the greater is the strength of the relationship. The Eigenvalue given in this analysis is .631.

The discriminant function thus has the power to separate the two groups. However, this does not mean that it will in fact separate them. The ultimate value of a discriminant model depends on the results obtained. That is what percentage of firms as classified correctly and is that percentage significant?

To answer the second question a test of proportions is needed. Of the 100 firms in the VLSPS group, 74 were classified correctly. Of the 100 firms in the RCF group, 86 were classified correctly. That is, 160 of the 200 firms in the study, or 80 percent were classified correctly. In the use of this methodology that ratio (160/200) is sometimes referred to as the "hit ratio, and is similar to R2 in regression. The results are shown in Table 1.

Table 1: VLSPS-RCF CLASSIFICATION RESULTS		
	Predicted Results	
Actual Results	VLSPS	RCF
VLSPS	74	26
RCF	14	86

Of course 80 percent is significant, but formal research requires the proof of a statistical test. To test whether or not an 80 percent correct classification rate is statistically significant, the Press's Q test is appropriate (Hair et al, 1998, p. 270). Press's Q is a Chi-square random variable:

Press's Q = [N-(n x k)]2 / N(k-1) *Formula (3)*

where:

N = Total sample size
n = Number of cases correctly classified
k = Number of groups

In this case:

Press's Q = [200-(160 x 2)]2 /200(2-1) = 72 > c2$_{.05}$ *3.84 with one d. f.* *Formula (4)*

The null hypothesis that the percentage classified correctly is not significantly different from what would be classified correctly by chance is rejected. The evidence suggests that the discriminant function performed very well in separating the two groups. Again, given the disparity of the two groups, it is not surprising that the function classified eighty percent correct.

The arithmetic signs of the adjusted coefficients in Table 2 are important to answer question number three. A positive sign indicates that the greater a firm's value for the variable, the more likely it will be in the VLSPS group. That is, it was greater than the cutoff value of zero, and designated as positive in Table 2. On the other hand, a negative sign for an adjusted coefficient signifies a Z score less than zero, and the greater a firm's value for the variable, the more likely it will be classified in the RCF group. If a variable such as the growth rate for any firm has a negative value, it could be additive toward the calculation of the Z score. Thus, according to Table 2, the greater the following variables: the price earnings growth ratio, the Value Line rankings for safety, timeliness, and the level of operating leverage (risk), the more likely the firm would achieve a high level of stock price stability. Conversely, the greater the returns to total capital, the higher the degree of financial leverage, and the more predictable the earnings, the more likely the firm would be randomly chosen for this study.

The relative contribution of each variable to the total discriminating power of the function may be obtained by standardizing (pooled within group variances) the canonical coefficients of the discriminant function. These coefficients are given in the output of the SPSS 11.5.0 program. The standardized canonical coefficients are shown in Table 2.

Table 2: Relative Contribution of the Variables

Adjusted Variables	Coefficient	Rank
X1 – The Return on total Capital	-0.074	7
X2 – The Price Earnings Growth Ratio	0.401	2
X3 – Long term Debt to Total Capital	-0.355	3
X4 – Operating Leverage-Unlevered Beta	0.306	5
X5 – The Value Line Safety Rating	0.452	1
X6 – The Value Line Timeliness Rating	0.141	6
X7 – Earnings Predictability	-0.333	4

Table 2 reveals that Value Line measure of safety of investment made the greatest contribution to the overall discriminating function. It is followed respectively by the price-earnings-growth ratio, the degree of financial leverage, earnings predictability, operating leverage, timeliness, and finally, the return to total capital. Some multicollinearity may exist between the variables, because return and the growth factor in the price earnings growth ratio may be a partial function of risk and leverage, and the numerator in the price earnings growth ratio may be a partial function of growth, return and risk. Hair et al. (1992) wrote that this consideration becomes critical in stepwise analysis and may be the factor determining whether a variable should be entered into a model. However, when all variables are entered into the model simultaneously, the discriminatory power of the model is a function of the variables evaluated as a set and multicollinearity becomes less important.

VALIDATION OF THE MODEL

Before any general conclusions can be drawn, a determination must be made on whether the model will yield valid results for any group of randomly drawn firms. The procedure used here for validation is referred to as the Lachenbruch or, more informally, the "jackknife" method. In this method, the discriminant function is fitted to repeatedly drawn samples of the original sample. The procedure estimates (k - 1) samples, and eliminates one case at a time from the original sample of "k" cases (Hair et al., 1992, p. 98). The expectation is that the proportion of firms classified correctly by the jackknife method would be less than that in the original sample due to the systematic bias associated with sampling errors. The major issue is whether the proportion classified correctly by the validation test differs significantly from the 80 percent classified correctly in the original test. That is, is the difference in the two proportions classified correctly by the two tests due to bias, and if so is that bias significant? The jackknife validation resulted in the correct classification of 76 percent of the firms. Since there are only two samples for analysis the binomial test is appropriate:

152 – 200(.80)/ [200 (.80) (.2)] 1/2 = - 1.41 is not less than t_{05} *-1.645* *Formula (5)*

Thus, the null hypothesis that there is no significant difference between the proportion of firms classified correctly in the original test and the proportion classified correctly in the validation test cannot be rejected. Therefore, it can be concluded that while there may be some bias in the original analysis, it is not significant. The procedure will classify new firms as well as it did in the original analysis.

In addition to the validation procedure, researchers usually address the question of the equality of matrices. One of the assumptions in using MDA is that the variance-covariance matrices of the two groups are equal. The SPSS program tests for equality of matrices by means of the natural logs of the determinants for the two covariance matrices. The greater the value of the log determinant the more the groups' covariance matrix differs. The log determinant for the VLSPS group was -1.858, and for the RCF group it was -.216. Whereas these are very small values, it would be logical to conclude that the matrices are equal. However, a formal statistical test is required in scholarly research. Box's M tests the significance of the log determinants, and thus, the assumption of homogeneity of covariance matrices. This test is very sensitive to meeting also the assumption of multivariate normality. (Garison, 2007). SPSS calculated M to be 84.006. M is then transformed by SPSS to the more familiar F statistic. The probability value of the F should be greater than the critical .05 level to demonstrate that the assumption of homoscedasticity is valid. (Garison, 2007; Hair et al., 1998). The F value for the test was 2.89, and the critical F.05 level is 1.69 with 29 and infinite degrees of freedom. Thus, the null hypothesis that the two matrices are equal cannot be rejected, and the midpoint value between the two group means (centroids) can be defined as the critical Z value. MDA is robust even when the homogeneity of variances assumption is not met, provided the data do not contain important outliers (Garison, 2007).

SUMMARY AND CONCLUSIONS

The purpose of this study was to establish a financial profile of firms that had achieved the highest ranking by Value Line for stock price stability in a period of economic recession, and to determine whether or not these firms have financial profiles that are significantly different from firms selected at random. The results of the statistical analysis indicated first, that there was a significant difference between financial variables that determine value, between the group of firms with high rankings for stock price stability, and firms chosen randomly, but from the same industries as the first group. The fact that the discriminant function separated two heterogeneous groups, and classified a significant proportion correctly is no surprise. In fact, the two groups of firms are so diverse in the matter of stock price stability that it would certainly have been a surprise if the discriminant function had not been so efficient. It was suggested that each group would have a unique financial profile. Table 2 summarizes the findings. According to Table 2, the greater the following variables: the price earnings growth ratio, the level of operating leverage (risk), the Value Line rankings for safety, and timeliness, the more likely the firm would achieve a high level of stock price stability. Conversely, the greater the returns to total capital, the higher the degree of financial leverage, and the more predictable the earnings, the more likely the firm would be randomly chosen for this study. Four of these results may have been expected, two were surprises, and one simply had no a priori expectations. The results on return to total capital, and financial leverage are consistent with the aforementioned study by Payne and Daghestani (1998). However, the findings for growth potential and operating risk were inconsistent with that study. Explanations of why the variables are associated with one group or the other are beyond the scope of this study, but again it suggests the need for further study. In any case, a few comments on the findings may be in order.

The variable ranked number one in discriminating power is the proxy for safety of investment. This should not be a surprise in a period of economic recession. It was expected that the Value Line ratings for safety, the market's perception of price-earnings-growth potential, and the Value Line measure for the timeliness of an investment would be associated with price stability. Investors may shift funds into stocks that are perceived to be safer in times of recession. It would simply have been illogical for safety, the price-earnings-growth ratio and timeliness to not be associated with price stability. On the other hand, operating leverage was also associated with price stability, and this was a surprise. Operating leverage is a function of fixed operating costs that have to be met whether there is any cash inflow or not. In a time of economic recession the cash inflows to cover fixed costs are more uncertain.

The debt to total capital ratio is a measure of financial leverage (risk), and as expected, it was not associated with price stability. Financial leverage is an indicator of profit potential, but it also signals financial risk. It was measured in this study by the long-term debt to total capital ratio. According to the analysis, the greater the degree of financial leverage the more likely the firm would not be one of the firms identified by Value Line as having a high level of price level stability. Given that debt, beyond a level considered judicious creates risk, this result may have been expected (Van Horne, 2001). Moreover, this somewhat reinforces the fact that fixed operating costs were surprisingly associated with price stability. However, there have been recent studies that found that financial risk was associated with one group, and operating risk was characteristic of another. Thus, some firms may offset high levels of one type of risk with low levels of the other. This finding would not be possible with the use of levered market betas published by various financial services.

There were no a priori expectations for the return to total capital. In general, firms could expect fewer returns in an economic recession, but there was no empirical evidence of this. Thus, it was simply not known in which group this variable would be associated.

The most surprising aspect of the study was that earnings predictability was not associated with price stability. Prices are supposed to be a partial function of future earnings, and thus, it was expected that high levels of earnings predictability would be associated with price stability. This was not the case, and may in fact, defy logic. Obviously, this is a subject that requires further study.

This study has resulted in a contribution toward the construction of a theory that describes the financial characteristics of firms that maintain high levels of price stability in periods of economic recession. In order to make a more complete contribution, further research is needed. For example, it may be instructive to do the same analysis during a modern period of expansion. The economy of the United States is in growth period at the time of this writing. If the expansion continues, data should soon be available for such a study. The construction of a complete theory would aid managers, investors, academicians, and investment counselors by providing greater of knowledge on which to base investment decisions.

ENDNOTES

[1] The measure of stock price stability used in this study is the Value Line Stock Price Stability Rating. It is defined by Value Line as a relative ranking of the standard deviation of weekly percent changes in the price of a stock over the past five years. The ranks range from 100 for the most stable to 5 for the least stable. As a group, each of the Value Line ratings have historically outperformed the next lowest rated group (the one hundreds have outperformed the nineties, which outperformed the eighties, etc.). Value Line results have outperformed the DOW by 15 to 1 over the last 35-years. (Investor Home, 1999). The impressive performance of the rating system led many to refer to it as part of the "Value Line Anomaly," or the "Value Line Enigma."

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THE RELATIONSHIP BETWEEN DIVIDEND PAYOUTS AND SYSTEMATIC RISK: A MATHEMATICAL APPROACH

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ABSTRACT

The traditional approach to evaluating dividend policy centers on how the payment of dividends ultimately affects a firm's stock price. The theoretical and empirical work in this area provides mixed results because firms have different motives for paying, not paying, or changing their dividends. In order to better understand how the dividend affects the firm, this paper focuses on how dividends affect a firm's level of systematic risk. Previous studies have used empirical analysis to show an inverse relationship between the payment of dividends and systematic risk. These studies, however, lack a theoretical explanation to accompany their findings. We provide a mathematical model that illustrates the relationship between dividends and systematic risk. In addition, we provide a further empirical analysis that is consistent with our model as well as previous studies.

INTRODUCTION

A primary area of research in the field of corporate finance centers on the relationship between dividends and stock prices. Early literature (Graham and Dodd 1951, and Durrand 1955) focuses on how the dividend payout ratio affects common stock prices, and it concludes that firms can affect the market value of their common stock by altering their dividend policy. Subsequent studies reveal that the relationship between dividends and stock prices is enormously complex and inconclusive. This paper isolates one component of stock price determination, systematic risk, and presents a mathematical model that illustrates how it is affected by a firm's dividend policy. By isolating the impact on systematic risk, we can draw conclusions about how firm value is affected by dividend policy in the absence of other mitigating factors. We also provide a statistical analysis that supports our model.

EARLY LITERATURE

In contrast to the earlier work of Graham and Dodd (1951) and Durrand (1955), Miller and Modigliani (1961) argue that dividends are irrelevant in a world with efficient capital markets, no taxes, and no transaction costs. Dividends, according to Miller and Modiglianai (hereafter M&M), simply reduce the value of the firm's stock by the amount of the dividend. In the absence of taxes and transaction costs, investors should be completely indifferent with regard to the firm's payment of dividends. From the firm's perspective, the key to their argument is that investment decisions are completely independent of dividend policy. If the amount of investment funds remaining after the dividend payout is not enough to meet desired investment outlays, the firm may seek external financing to compensate for their shortage of funds. Therefore, the level of dividends will never affect the investment decision.

Many studies concur with the finding that dividends are an irrelevant determinate of firm value, even after relaxing the restrictive assumptions imposed by M&M. Farrar and Selwyn (1967), for example, show that the irrelevance of dividend policy exists in a world with corporate income taxes but no personal income taxes. If both personal income taxes and corporate income taxes are considered, and capital gains are taxed at a lower rate, they argue that a zero dividend policy is optimal.

Miller and Scholes (1978) show that Farrar and Selwyn may be mistaken in arguing for a zero dividend policy when divergent tax rates on dividends and capital gains exist. When the marginal tax rate on capital gains is lower than the marginal tax rate on dividends received, personal income taxes can be avoided by sheltering taxable dividend income. As a result, investors will be indifferent between dividend income and capital gains, and the original M&M argument that dividends are irrelevant holds.

Without denying the theoretical irrelevancy of dividend policy, Bhattacharya (1979) tries to explain why firms actually do pay dividends. Bhattacharya looks at the favorable signal conveyed by unexpected dividend increases. Because less successful firms would be unlikely to increase dividends (send false signals), an unexpected increase in the dividend is likely to convey positive information with regard to the firm's future prospects (see also, Pettit 1972, Aharony and Swary 1980, Asquith and Mullins 1983, Eades, Hess and Kim 1985, and Richardson, Sefcik and Thompson 1986). Accordingly, a higher than expected dividend would be associated with an increase in the stock price.

If the firm announces an unexpected dividend decrease, the signal is normally perceived as pessimistic, and the firm's stock price will react in a negative manner (c.f., Pettit 1972, Aharony and Swary 1980, Eades, Hess and Kim 1985). With no change in dividend policy, the conclusions are inconsistent. For example, Aharony and Swary (1980) observe no significant reaction to status quo dividend announcements, while Eades, Hess and Kim (1985) observe significant excess returns for days -1 thru +1 surrounding a status quo announcement.

In addition to being an effective signaling mechanism, dividends may also function as a means of serving a specific investor clientele (Pettit, 1977), or they may be used to reduce agency costs (Easterbrook, 1984). Whatever the reason, firms have a long history of paying dividends, and attempts to isolate the impact of the dividend on the price of the underlying stock have been met with mixed results. This is not unexpected, given the variety of reasons firms have for paying dividends.

Rather than seeking a direct link between dividend policy and stock prices, several empirical studies have focused on how dividend policy affects stock price volatility and the firm's level of systematic risk. A negative relationship was found to exist between payout ratios and firm betas in studies by Beaver, Kettler and Scholes (1970), Ben-Zion and Shalit (1975), and Lee, Liaw and Rahman (1986). The thinking behind this theory stems from how variances in dividends affect the timing of an asset's cash flows. Dyl and Hoffmeister (1986) argue that dividend policy affects security duration and, ultimately, the riskiness of the underlying stock. Duration, as demonstrated by Macaulay (1938), is the elasticity of the value of a capital asset with respect to changes in the discount factor. It is calculated as the weighted average of the length of time needed to recover the current cost of the asset. A high dividend paying stock has a shorter duration because of more near-term cash flow. The earlier one receives payment, the less susceptible is the value of a capital asset to changes in the discount factor. With the dividend in hand, investors are subject to less interest rate risk and, as a result, a reduced level of systematic risk. All other things being equal, the reduced level of systematic risk will influence the firm's cost of capital and, finally, the firm's stock price (Gordon, 1959).

While the inverse relationship between dividend yield and systematic risk is generally accepted in the finance field, it falls short of a true mathematical reasoning. Dyl and Hoffmeister (1986) admit this fact in two separate instances:

> *…one should be able to observe an empirical relationship between a firm's beta and its dividend policy (e.g., payout ratio). In fact, a number of researchers have observed this relationship although they have not provided any rationale for its existence.*
>
> *…firms pay cash dividends in order to influence the riskiness of their common stock. Although admittedly this is merely an interesting conjecture, as [sic] a minimum a link between the firm's dividend policy and the riskiness of its common stock has been established.*

RECENT LITERATURE

For a time, the nature of dividends and dividend policy shifted toward a preference for share repurchases in lieu of cash dividends. Grullon and Michaely (2002) show that from 1980 to 2000, share repurchases grew at an average annual rate of 26.1 percent while dividends grew at an average annual rate of 6.8 percent. However, the Jobs and Growth Tax Relief Reconciliation Act of 2003, which lowered the top marginal tax rate on dividends to 15 percent, seems to have reversed this trend. Chetty and Saez (2005) find a 20 percent increase in dividend payments by non-financial and non-utility publicly traded companies following the 2003 tax cut. Brown, Liang, and Weisbenner (2007) show an even more pronounced trend toward the payment of dividends when executives own a large percentage of stock. These trends seem to signify an unwillingness or an inability of individuals to shelter highly taxed dividends, thus rendering the irrelevance proposition more valid for investors now that tax rates on capital gains and dividends are not divergent.

With the tax consequences for dividends versus capital gains eliminated, the firm is once again faced with determining an optimal dividend policy. Brav, Graham, Harvey, and Michaely (2005) surveyed and interviewed 384 financial executives to determine why they pay dividends. The results of their survey indicate the predictable reasons – avoidance of negative consequences, signaling, common stock valuation, making the firm less risky, etc… Still, no quantifiable reason is given for how or why the firm becomes less risky, even though financial executives continue to site it as a reason for paying dividends. Our study fills this gap in the literature and addresses the concerns raised by Dyl and Hoffmeister (1986) by providing a mathematical model illustrating the relationship between dividend yield and systematic risk. We then include a statistical analysis that supports our theoretical findings.

MODEL DEVELOPMENT

Gordon's (1959) constant growth version of the dividend valuation model can be used to illustrate the relationship between dividend yield and risk. Gordon's model states that the value of a share of common stock is the present value of the expected returns to that share. Thus, the model is stated as:

$$P = \sum_{t=1}^{n} \frac{D_1}{(1+k)^t} \qquad (1)$$

Where P is the stock price, D_t is the level of dividends, and k is the investor's required rate of return. If the dividend stream is expected to grow at a perpetual rate, equation (1) can be written as:

$$P_0 = \frac{D_1}{(k-g)} \qquad (2)$$

where g is the constant growth in dividends and k>g. This, of course, is the common *Gordon Constant Growth Model* that is routinely taught in many basic finance courses. The model is also commonly expressed in terms of the investor's required rate of return, which is written as:

$$k = \frac{D_1}{P_0} + g \qquad (3)$$

To develop the relationship between dividend policy and risk, first take the total differential of equation (2):

$$dP = \left[\frac{1}{(k-g)}\right]\partial D + \left[\frac{-D}{(k-g)^2}\right]\partial k + \left[-\frac{(-D)}{(k-g)^2}\right]\partial g \qquad (4)$$

which gives us:

$$dP=\left[\frac{D}{(k-g)}\right]\times\left\{\frac{\partial D}{D}+\left[\frac{1}{(k-g)}\right]\times(\partial g-\partial k)\right\} \tag{5}$$

Since $g=\frac{\partial D}{D}$, ∂P simplifies to equation (6):

$$dP=P\left[g+\frac{D}{(k-g)}\times\frac{1}{D}(\partial g-\partial k)\right] \tag{6}$$

We then solve equation (6) for $\frac{dP}{P}$, which yields:

$$\frac{dP}{P}=g+\frac{(\partial g-\partial k)}{Y} \tag{7}$$

where $Y=\frac{D}{P}$ is the dividend yield, and $\frac{dP}{P}$ is the capital gain.

Equation (7) can be extended to show a theoretical relationship between dividend yield and return. Stockholder's expected return can be expressed as:

$$R=Y+\frac{dP}{P} \tag{8}$$

Substituting equation (7) into equation (8) yields:

$$R=Y+g+\frac{\partial g-\partial k}{Y} \tag{9}$$

Finally, substituting equation (3) into equation (9) yields:

$$R=k+\frac{\partial g-\partial k}{Y} \tag{10}$$

Since $P = \frac{D}{(k-g)}$ implies $k - g = \frac{D}{P}$,

the lower the dividend yield, the greater the impact changes in g and changes in k has on required return. From equation (10) then, with a low dividend yield, a large increase in g will result in a large increase in returns and a large increase in k will result in a large decrease in returns. Since the expected return on any asset is a linear function of its systematic risk, a low dividend yield will result in a higher risk, all other things being equal.

EMPIRICAL RESULTS

To test our model, 100 firms were randomly selected from the Standard & Poor's 500 Index. Daily adjusted closing prices were obtained from Yahoo Finance for the sample firms on each trading day from January 2, 2002 through December 31, 2006. Twelve firms were omitted from the final sample because they did not trade continuously under the same ticker symbol for the entire 5-year observation period. Thus, the final sample totaled 88 firms. Individual firm betas were then computed as a measure of systematic risk for all 88 firms in the sample. Betas were computed using a simple linear regression of daily returns for each firm against the daily returns of the Standard & Poor's 500.

In testing the relationship between systematic risk and dividend policy, we regressed the firm betas on the dividend yield for each of the 88 firms in our sample. Dividend yields were obtained from Yahoo Finance based on the January 16, 2007 closing prices. Our regression results are shown in Table 1. As expected from equation (10), we found a significant inverse relationship between a firm's dividend yield and the corresponding level of systematic risk. This confirms that a firm's dividend yield should be considered as a determining factor in the assessment of a firm's level of systematic risk. Moreover, individual firms may be able to impact the risk level of their common stock by altering their dividend policy. In so doing, firm's may be able to realize the benefits of a lower cost of capital and broader access to long term capital markets.

Table 1: Regression Results

	Coefficients	Standard Error	t-Stat	P-value
Intercept	1.002790638	0.072153532	13.89801	1.055E-23
Dividend Yield	-8.250879741	3.637876459	-2.26805	0.0258317

CONCLUSION

The debate surrounding the impact of dividend policy on firm value is without resolution after over 50 years of analysis. This is not unexpected given that affecting firm value is only one of a multitude of reasons firms have for actually paying dividends. In addition, the recipient clientele of a dividend paying firm may also assert both positive and negative influence on the stock price depending on their disposition toward dividends and capital gains. A high yield firm, for example, subjects its shareholders to possible tax penalties should investors choose not to shelter their income *a la* Miller and Scholes (1978). They may also incur additional costs if external financing is needed to fund ongoing operations. On the other hand, many shareholders will shelter dividend income, and many firms will not incur additional costs of external financing if adequate internal funds are available. Thus, the same policy may affect two different sets of investors and two different firms in opposite ways. Consequences, such as these, coupled with the reduced interest rate risk associated with high yield stocks, are consistent with the broad range of theoretical and empirical findings with regard to dividend policy.

We have chosen to narrow the focus of dividend policy and isolate how it affects the systematic risk of the firm. In so doing, we separated the motivation for paying a dividend from the immediate impact the dividend itself (or lack thereof) has on the firm. Our model shows that when all other things are held constant, there will be a clear inverse relationship between dividend payout ratios and the systematic risk of the firm.

To broaden the interpretation of our findings and apply them to firm value requires consideration of several other factors that we have previously discussed. At this point, our model is not robust with regard to such things as signaling effects or clientele tax shields. This, of course, leaves us with an opening for further refinement of our model and additional research.

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GUO'S DUMMY SPECULATION: BLIND INVESTMENTS ON RISING OR FALLING STOCKS

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ABSTRACT

This paper simulates the stock market, during the bull market period, and attempts to speculate and profit from buying stocks with a sharp drop in excess of 10% and those with a sharp increase of 10% in daily stock prices. Using the descriptive analysis, coefficient of correlation and optimal scaling of regression, the results statistically showed that speculating in stocks with a daily drop of more than 10% will have an overall positive return, while speculating in stocks with a daily rise of more than 10% will have an overall negative return. It also proved a significant correlation between the stocks' earnings per share (EPS) and their returns. The significant regression models, between the EPS and returns, showed that EPS is an important indicator for the return in this speculation, under such a scenario. Although, this study needs to be replicated during the bear market period, it does provide some very interesting results.

INTRODUCTION

Investment strategies can be broadly divided into two types: hedging and speculating. Hedging is an investment made in order to reduce the risk of adverse price movements in a security, by taking an offsetting position in a related security, such as an option or a short sale. Speculating includes taking large risks, especially with respect to trying to predict the future; it is similar to gambling, in the hopes of making quick, large gains (Investorword.com, 2004).

Advocates of hedge funds point to their superior absolute returns as well as superior risk-adjusted returns, and their low correlation with stock market return. Also, hedge funds depend on the selection skill of managers to produce performance (Jahnke, 2004). Whether the decision is made to hedge or speculate, the aim is to make a profit thus avoiding a loss.

This paper will proceed from a speculative perspective in the real stock market, attempting to make a profit in the stock market in a short term period - of not more than one week - by buying two major types of stocks: stocks with a daily drop of more than 10% in stock price and stocks with a daily increase more than 10% in stock price.

LITERATURE REVIEW

AMW and others from the technical and quantitative school confronted the Efficient Market Hypothesis and showed that prices do not always adjust quickly to information shocks as financial theory would suggest. They also showed that a deficiency in the quality of information and its effect on price in specific markets for limited periods of time can offer a trading window using simple technical trading methods. In short, an analysis of past prices can earn abnormal profits for the investor (Tam, 2002). Therefore, there are always opportunities for speculators to profit from the markets by the analysis of past prices, and by the use of technical trading methods. Technical analysis (Investword.com, 2004) tries to evaluate securities by relying on the assumption that market data, such as charts of price, volume, and open interest, can help predict future (usually short-term) market trends. And the use of technical analysis to predict security price movements from past price series has been supported by a number of academic research studies (Summers, Griffiths, and Hudson, 2004).

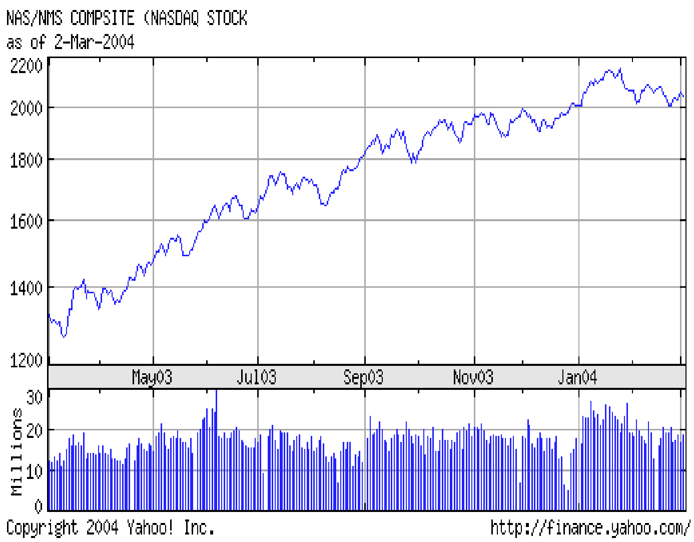
A cornerstone of technical analysis is the Dow Theory which states that in a true bull or bear trend, both the Dow Jones Industrial Average (DJIA) and Dow Jones Transportation Average (DJTA) must be moving in the same direction. In general, Dow Theory adherents will buy when the market moves higher than a previous peak and sell when it goes below the preceding valley (Moneycentral.msn.com, 2004). Also, Castle in the Air theory (Malkiel, 2003) suggests that investors will be attracted to high priced stocks, due to the psychic behaviors of investors, who believe stock prices will go even higher.

On the other hand, it is also suggested that bullish investors buy a stock in the hope it will go up, buy low and sell high (Sands, 2004), therefore realizing a profit. Basing speculations on the Dow Theory, if the stocks have gone higher than the previous peak, the Dow Theory adherents should buy, because they are likely to profit. Basing speculation on the rule of buy low and sell high under bullish conditions, one would buy stocks when they drop lower than their values, and sell it at a higher price in order to earn a profit.

To profit from the Dow Theory of buy high, sell higher and the rule of buy low, sell high, one needs to determine whether the market is a bull or bear market. Fisher suggests that 2004 will be a good year for equities (Fisher, 2004). Reviewing the past year, the Dow Jones average has gone up from 7,416.64 to 10,753.63 (DJ Industrial Average, 2004). NASDAQ has increased from 1,253.22 to 2,153.83(NAS/NMS Composite, 2004). Therefore, it appears the bull markets have returned.

In a bull market, one can draw out some of the real stock data to test whether the Dow Theory of buy high, sell higher is profitable, or whether buy low, sell high is preferred. According to the Central Limit theorem, the fundamental result that the sum (or mean) of independent identically distributed random variables with finite variance approaches a normally distributed random variable as their number increases. And in particular, if enough samples are repeatedly drawn from any population, the sum of the sample values can be thought of, approximately, as an outcome from a normally distributed random variable (Word reference, 2004). Therefore, if the data, which is a sample of the stock market population, is significant, then it should prove whether the Dow Theory of buy high, sell higher is profitable, and if buy low, sell high brings earnings in a speculative perspective.

Bull Markets of Dow Jones and NASDAQ



Source: http://finance.yahoo.com

GENERAL HYPOTHESES

According to the Castle in the Air theory, stocks will continue to go up. Therefore, it is expected the stocks with a daily dramatic increase greater than 10% will have a positive return performance in the following days, so:

H1: Ho: $R \leq 0$ Ha: $R > 0$

It is also expected that the stocks with a daily dramatic decrease greater than 10% will have a positive return performance in the following days according to the buy low, sell high rule, so:

H2: Ho: $R \leq 0$ Ha: $R > 0$

Based on the Fundamental Analysis (Brown and Riley, 2004), stocks with better earnings will have better performance than stocks with lower earnings. Therefore, it is predicted that the randomly selected stocks with a daily dramatic increase greater than 10% and a positive EPS will have a better return performance than the stocks with a negative EPS:

H3: Ho: R (+EPS) = R (−EPS) Ha: R (+EPS) > R (− EPS)

If the Fundamental Analysis holds, there must be a correlation (~) between EPS with the return performance of the stocks; therefore, it is predicted that if the randomly selected stocks have a daily dramatic increase greater than 10% then their EPS is correlated to their returns:

H4: Ho: R ~ (+ EPS) Ha: R ×~ (+ EPS)

Under the same situation, based on Fundamental Analysis for stocks with a dramatic decrease greater than 10%, stocks with better earnings will perform better than stocks with worse earnings. Therefore, it is predicted that, stocks with a daily dramatic decrease greater than 10% and a positive EPS will have a better return performance than the stocks with a negative EPS:

H5: Ho: R (+EPS) = R (− EPS) Ha: R (+EPS) > R (− EPS)

Also, it is predicted that, if the randomly selected stocks have a daily decrease greater than 10% then their EPS is correlated to their return:

H6: Ho: R ~ (+ EPS) Ha: R ×~ (+ EPS)

If there is correlation between the EPS and the return performance for the stocks, there must be a regression model that can represent the relationship, because EPS determines the return performance; therefore, it is predicted that randomly selected stocks with a daily dramatic increase greater than 10% will have a regression model of:

H7: Ho: $R = EPS + e$ Ha: $R \neq EPS + e$

It is also predicted that the randomly selected stocks with a daily dramatic decrease greater than 10% will have a regression model of:

H8: Ho: $R = EPS + e$ Ha: $R \neq EPS + e$

DATA SOURCE AND METHODOLOGY

Data were exclusively and randomly collected daily from the Yahoo! Finance stock screener, from Feb 3, 2004 to Feb 20, 2004. One hundred forty-seven stocks with a daily increase of more than 10% were randomly selected and 76 stocks with a daily decrease of more than 10% were randomly selected.

Dow Jones and NASDAQ stocks with a daily dramatic increase or decrease more than 10% in stock prices were collected along with their EPS. This provided two sample pools. One sample pool with stocks that have a daily increase greater than 10% in stock price and one with stocks that have a daily decrease greater than 10% in stock price. The return performance of these stocks in the following 4 days was traced; their geometric returns in the following 2 days, 3 days and 4 days were calculated and used for statistical analyses together with their individual EPS.

The raw data was analyzed with SPSS to evaluate their descriptive statistics. These data were categorized and run to compare their means according to their EPS and to test the correlation between the EPS and the returns. Also, and evaluation was conducted as to whether a regression model exists between EPS and the return by running the Optimal Scaling of Regression. The Optimal Scaling examines the underlying metrics of data gathered from different a priori known populations (Mullen, 1995). Essentially, Optimal Scaling takes the data as ordinal or nominal and re-scales it in order to uncover the optimal relationship between predicting dependent and independent variables.

FINDING AND ANALYSES

Table I shows the result that stocks with an increase greater than 10%, will not have a positive mean return performance in the following days. The mean returns in Table 1 are all less than zero in the following one-day to four-day returns. Therefore, we fail to reject Ho of Hypothesis 1, for stocks with a daily increase greater than 10% will not have a positive return performance in the following days.

Table I: Stocks with an increase greater than 10% and their returns

	N	Minimum	Maximum	Mean	Std. Deviation
return1d	147	-2.45000	.33230	-.0201892	.21162339
return4d	142	-.07482	.10778	-.0029510	.02377460
return3d	147	-2.50602	.14169	-.0360473	.2696371
return2d	145	-.14311	.14752	-.0049578	.03739231
Valid N (listwise)	142				

Table II shows stocks with a daily dramatic decrease greater than 10% and their mean returns. The mean returns for these stocks are all positive. Therefore, Ha of Hypothesis 2 stands. The day following a decrease gives the greatest return among all the different day returns. In addition the longer the time to invest under this scenario, the less the mean returns.

In the rescaling version of this test, the deciles are used instead of the raw data versions in Table I and II. Table III shows stocks with a daily dramatic increase greater than 10% and their deciles of returns in 1-day, 2-day, 3-day, 4-day returns and their EPS. It statistically suggests that 1-day, 2-day, 3-day and 4-day returns are significant at a 95% confidence level, reject Ho of Hypothesis 3. Therefore, the stocks with a positive EPS will have a better return than those with a negative EPS

Table II: Stocks with a decrease greater than 10% and their mean returns					
	N	Minimum	Maximum	Mean	Std. Deviation
retrn1d	76	-.34070	1.63000	.0294776	.20128841
dretrn4d	76	-.06938	.24174	.0068428	.03788476
dretrn3d	76	-.10727	.36166	.0070437	.05398998
dretrn2d	76	-.13931	.56897	.0087518	.07691867
Valid N (listwise)	76				

Table III: Stocks with a daily increase greater than 10% -- With a positive EPS vs. with a negative EPS									
	Levene's Test for Quality of Variance		t-test for Equality of Means						
	F	Sig	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	95% Confidence Interval of the Difference	
								Lover	Upper
NTILES of VAR00001									
Equal variance Assumed	2.356	.127	-2.268	145	.025	-1.096	.483	-2.052	-.141
Equal variance Not assumed			-2.329	120.098	.022	-1.096	.471	-2.028	-.164
NTILES of RETURN2D									
Equal variance Assumed	.617	.434	-3.050	143	.003	-1.467	.481	-2.417	-.516
Equal variance Not assumed			-3.105	114.551	.002	-1.467	.472	-2.402	-.531
NTILES of RETURN3D									
Equal variance Assumed	.073	.787	-3.127	145	.002	-1.487	.476	-2.428	-.547
Equal variance Not assumed			-3.134	111.665	.002	-1.487	.475	-2.428	-.547
NTILES of RETURN4D									
Equal variance Assumed	.002	.968	-2.582	140	.011	-1.270	.492	-2.242	-.297
Equal variance Not assumed			-2.579	103.370	.011	-1.270	.492	-2.246	-.293

Table IV shows the stocks with a daily increase greater than 10%, their correlation (~) between the deciles of EPS and the deciles of return performance in 1-day, 2-day, 3-day and 4-day. The return performances are significant at a 95% confidence level. So, stocks with a daily increase greater than 10% and their deciles of EPS are correlated to their return performance.

Table IV: Stocks with a daily increase greater than 10% -- Correlation (~) between EPS and return performance

	Correlations				
	NTILES of VAR00001	NTILES of RETURN2D	NTILES of RETURN3D	NTILES of RETURN4D	NTILES of EPS
NTILES of VAR00001					
Pearson Correlation	1	.616**	.575**	.576**	.182*
Sig. (2-tailed)		.000	.000	.000	.029
N	147	145	147	142	144
NTILES of RETURN2D					
Pearson Correlation	.616**	1	.825**	.675**	.323**
Sig. (2-tailed)	.000		.000	.000	.000
N	145	145	145	142	143
NTILES of RETURN3D					
Pearson Correlation	.575**	.825**	1	.835**	.289**
Sig. (2-tailed)	.000	.000		.000	.000
N	147	145	147	142	144
NTILES of RETURN4D					
Pearson Correlation	.576**	.675**	.835**	1	.206*
Sig. (2-tailed)	.000	.000	.000		.014
N	142	142	142	142	141
NTILES of EPS					
Pearson Correlation	.182*	.323**	.289**	.206*	1
Sig. (2-tailed)	.029	.000	.000	.014	
N	144	143	144	141	144

** Correlation is significant at the 0.01 level (2- tailed)
* Correlation is significant at the 0.05 level (2-tailed)

Table V shows stocks with a daily decrease greater than 10%, their deciles of 1-day, 2-day, 3-day and 4-day returns and their EPS. Since T-test for all is not significant at 95% confidence level, we fail to reject Ho of Hypothesis 4, or we failed to say that for the stocks with a daily decrease greater than 10%, the returns for positive EPS stocks perform better than negative EPS stocks.

Table V: Stocks with a daily decrease greater than 10% -- With a positive EPS vs. with a negative EPS Independent Samples Test									
	Levene's Test for Quality of Variance		t-test for Equality of Means						
	F	Sig	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	95% Confidence Interval of the Difference	
								Lover	Upper
NTILES of VAR00001									
Equal variance Assumed	.302	.584	-1.269	74	.208	-.904	.712	-2.323	.515
Equal variance Not assumed			-1.278	42.574	.208	-.904	.707	-2.331	.523
NTILES of RETURN2D									
Equal variance Assumed	.094	.761	-1.003	74	.319	-.717	.715	-2.142	.708
Equal variance Not assumed			- .979	39.700	.334	-.717	.732	-2.198	.764
NTILES of RETURN3D									
Equal variance Assumed	1.018	.316	-1.003	74	.319	-.717	.715	-2.142	.708
Equal variance Not assumed			-.959	37.976	.344	-.717	.748	-2.231	.797
NTILES of RETURN4D									
Equal variance Assumed	.087	.769	-1.815	74	.074	-1.278	.704	-2.681	.125
Equal variance Not assumed			-1.785	40.352	.082	-1.278	.716	-2.725	.169

Table VI shows the stocks with a daily decrease greater than 10%, their correlation (~) between the deciles of EPS and the deciles of return performance in 1-day, 2-day, 3-day and 4-day. Since all correlations are not significant at a 95% confidence interval, the Ho of Hypothesis 6 cannot be rejected. For stocks with a daily decrease greater than 10%, their deciles of EPS are correlated to their deciles of returns.

Tables VIIa, VIIb, VIIc and VIId show the outputs of running Regression's Optimal Scaling in SPSS, of stocks with a daily increase greater than 10%, with a regression model for their deciles of EPS and deciles of return performance in 1-day, 2-day, 3-day and 4-day, respectively. Table 8.1, 8.2, 8.3 and 8.4 show the outputs of running Regression's Optimal Scaling, of stocks with a daily decrease greater than 10%, with a regression model for their deciles of EPS and deciles of return performance in 1-day, 2-day, 3-day and 4-day, respectively.

Table VI: Stocks with a daily decrease greater than 10% -- Correlation (~) between EPS and return performance					
	Correlations				
	NTILES of VAR00002	NTILES of DRETRN4D	NTILES of DRETRN3D	NTILES of DRETRN3D	NTILES of EPS
NTILES of VAR00002					
Pearson Correlation	1	.592**	.626**	1774**	.028
Sig. (2-tailed)		.000	.000	.000	.809
N	76	76	76	76	76
NTILES of DRETRN4D					
Pearson Correlation	.592**	1	.844**	.696**	.007
Sig. (2-tailed)	.000		.000	.000	.952
N	76	76	76	76	75
NTILES of DRETRN3D					
Pearson Correlation	.626**	.844**	1	.777**	-.012
Sig. (2-tailed)	.000	.000		.000	.919
N	76	76	76	76	75
NTILES of DRETR24D					
Pearson Correlation	.774**	.696**	.777**	1	.028
Sig. (2-tailed)	.000	.000	.000		.809
N	76	76	76	76	75
NTILES of EPS					
Pearson Correlation	.028	.007	-.012	.028	1
Sig. (2-tailed)	.809	.952	.919	.809	
N	75	75	75	75	75
** Correlation is significant at the 0.01 level (2- tailed)					

Table VIIa shows stocks with a daily increase greater than 10%, a regression model for 1-day deciles of return and their deciles of EPS. The regression model is significant at a 99% confidence level, which means the regression model is valid; The R square of 0.073 says the model explains 7.3% of the 1-day returns, and even with only 144 observations, this relationship is statistically significant. In Chart I, the deciles of 1-day return (shown in chart as VAR00001) and the deciles of EPS are both showing monotonic upwards trends. The implication for the rescaling of 1-day return is that there are three important levels, the lowest level for the first, second, and third deciles, a middle level for fourth to eighth deciles, and a high level for the top two deciles. Approximately, the EPS variable is also rescaled as having three levels, lowest level for first to fourth deciles, a middle level for fifth to seventh deciles and a high level for the top three deciles. When this done, the resulting correlation is maximized.

The result of Optimal Scaling indicates the lowest level of 1-day return is correlated to the lowest level of EPS, the middle level of 1-day return is correlated to the middle level of EPS and the high level of 1-day return is correlated to the high level of EPS.

Table VIIa stocks with a daily increase greater than 10% --A regression model for their deciles of 1-day return and deciles of EPS					
Model Summary					
Multiple R		R Square		Adjusted R Square	
.270		.073		.066	
ANOVA					
	Sum of Squares	df	Mean Square	F	Sig
Regression	10.471	1	10.471	11.136	.001
Residual	133.529	142	.940		
Total	144.000	143			

Chart I

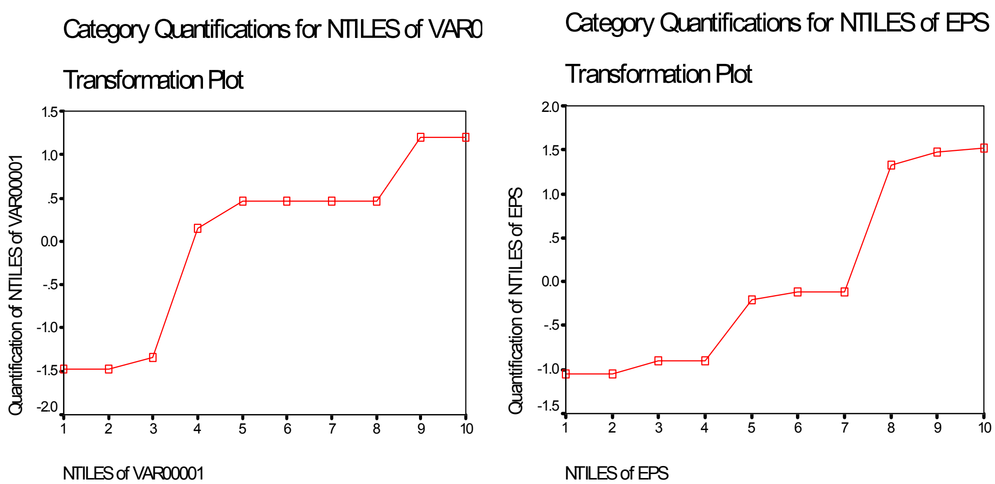


Table VIIb shows stocks with a daily increase greater than 10%, a regression model for 1-day deciles of return and their deciles of EPS. The regression model is significant at a 99% confidence level, which means the regression model is valid. The R square of 0.073 indicates the model explains 17.3% of the 2-day return. In Chart II, the deciles of 2-day return (shown in chart as Return2D) and the deciles of EPS are both showing monotonic upwards trends. It implied five important levels – the lowest level for the first deciles, second lowest level for deciles from two to four, a middle level for deciles five and six, second highest level for deciles seven to nine, and the highest level for tenth deciles. EPS also rescaled as having five levels, the lowest level for the first deciles, second lowest level for deciles from two to four, a middle level for deciles five to eight, second highest level for deciles nine, and the highest level for tenth deciles. And these different levels in 2-day return are correlated to the counterpart levels in EPS.

Table VIIb stocks with a daily increase greater than 10% --A regression model for their deciles of 2-day return and deciles of EPS					
Model Summary					
Multiple R		R Square		Adjusted R Square	
.415		.173		.167	
ANOVA					
	Sum of Squares	df	Mean Square	F	Sig
Regression	24.687	1	24.687	29.421	.000
Residual	118.313	141	.839		
Total	143.000	142			

Chart II

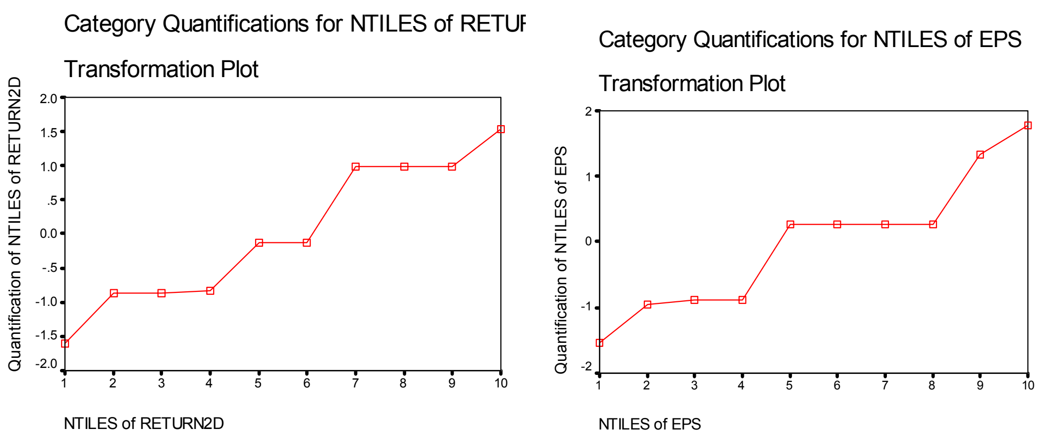


Table VIIc shows stocks with a daily increase greater than 10%, a regression model for 1-day deciles of return and their deciles of EPS. The regression model is significant at a 99% confidence level, which means the regression model is valid. The R square of 0.141 indicates the model explains 14.1% of the 3-day return. In Chart III, the deciles of 3-day return (shown in chart as Return3D) and the deciles of EPS are both showing a monotonic upward trend. The rescaling of 3-day return tells that there are three important levels- the lowest level for the first to fourth deciles, a middle level for fifth to sixth deciles, and a high level for the top four deciles. Approximately, the EPS variable is also rescaled as having three levels, lowest level for first deciles, a middle level for second to ninth deciles and a high level for tenth deciles. The result of Optimal Scaling tells us that the lowest level of 3-day return is correlated to the lowest level of EPS, middle level of 3-day return is correlated to the middle level of EPS and the high level of 3-day return is correlated to the high level of EPS.

Table VIIc stocks with a daily increase greater than 10% --A regression model for their deciles of 3-day return and deciles of EPS					
Model Summary					
Multiple R		R Square		Adjusted R Square	
.376		.141		.135	
ANOVA					
	Sum of Squares	df	Mean Square	F	Sig
Regression	20.312	1	20.312	23.319	.000
Residual	123.688	142	.839		
Total	144.000	143			

Chart III

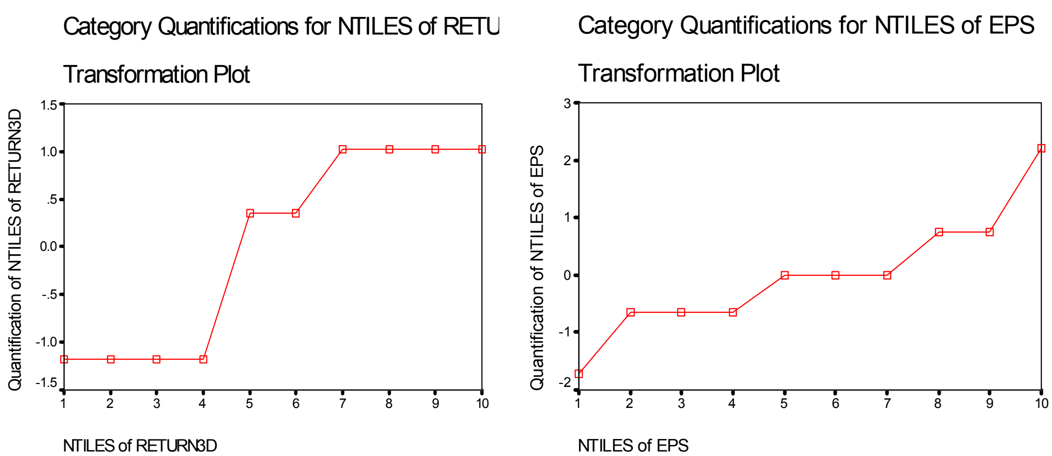


Table VIId shows stocks with a daily increase greater than 10%, a regression model for 1-day deciles of return and their deciles of EPS. The regression model is significant at a 99% confidence level, which means the regression model is valid. The R square of 0.111 indicates the model explains 11.1% of the 4-day returns. In Chart IV, the rescaling of 4-day return shows there are two important levels, a lowest level for first to fifth deciles and a top level for sixth to tenth deciles. And EPS can be approximately rescaled into 2 levels as well, a lower level from first to seventh deciles and a top level from eighth to tenth deciles. These different levels in 2-day return are correlated to the counterpart levels in EPS.

Table VIId stocks with a daily increase greater than 10% --A regression model for their deciles of 4-day return and deciles of EPS					
Model Summary					
Multiple R		R Square		Adjusted R Square	
.333		.111		.104	
ANOVA					
	Sum of Squares	df	Mean Square	F	Sig
Regression	15.634	1	15.634	17.334	.000
Residual	125.366	139	.902		
Total	141.000	140			

Chart IV

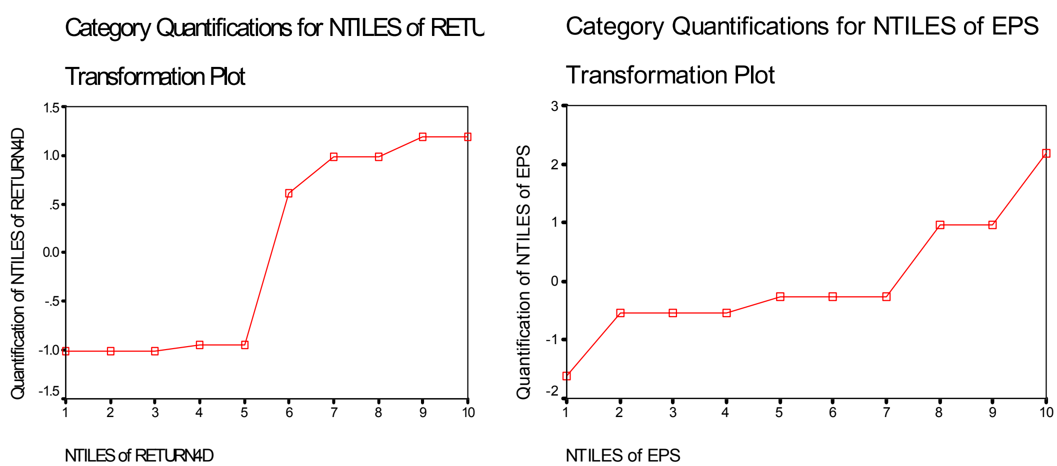
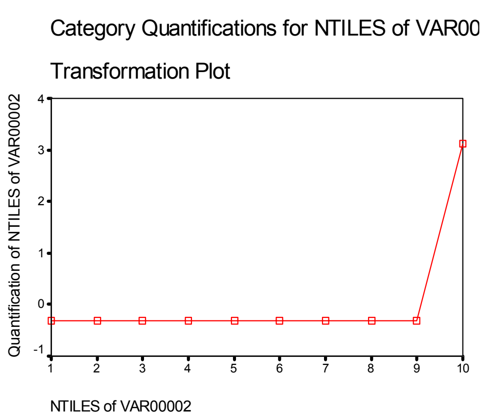


Table VIIIa shows stocks with a daily decrease greater than 10%, a regression model for 1-day deciles of return and their deciles of EPS. The regression model is significant at a 99% confidence level, which means the regression model is valid. The R square of 0.074 indicates the model explains 7.4% of the 1-day returns. In Chart V, the deciles of 1-day return (shown in chart as Var00002), the rescaling of 1-day return shows that there are two important levels, a lower level from first to ninth deciles and a high level of tenth deciles. For EPS, there are two important levels, lower level from first deciles to fifth deciles and a top level from sixth deciles to tenth deciles. And these different levels in 2-day return are correlated to the counterpart levels in EPS.

Table VIIIa stocks with a daily decrease greater than 10% --A regression model for their deciles of 1-day return and deciles of EPS		
Model Summary		
Multiple R	R Square	Adjusted R Square
.271	.074	.061

ANOVA					
	Sum of Squares	df	Mean Square	F	Sig
Regression	5.525	1	5.525	5.805	019
Residual	69.475	73	.952		
Total	75.000	74			

Chart V



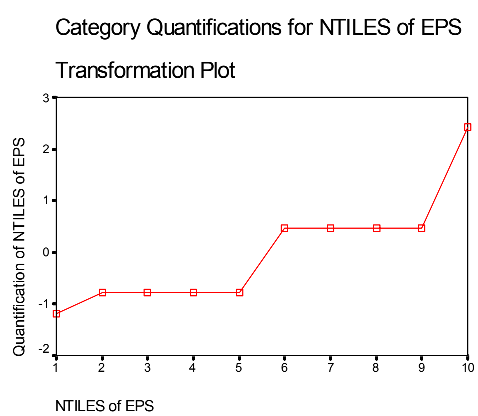


Table VIIb shows stocks with a daily decrease greater than 10%, a regression model for 1-day deciles of return and their deciles of EPS. The R square of 0.063 indicates the model explains 6.3% of the 2-day returns. Chart VI shows the deciles of 2-day return (shown in chart as Dretrn2D), the rescaling of 2-day return shows three important levels, the lowest level consists of first to eighth deciles, a middle level of ninth deciles, a high level of tenth deciles. For EPS, it also shows 3 important levels, the lowest level for the first deciles, a middle level for second to ninth level, and a high level for the top deciles. These different levels in the 2-day return are correlated to the counterpart levels in EPS.

Table VIIIb stocks with a daily decrease greater than 10% --A regression model for their deciles of 2-day return and deciles of EPS					
Model Summary					
Multiple R		R Square		Adjusted R Square	
.252		.063		.051	
ANOVA					
	Sum of Squares	df	Mean Square	F	Sig
Regression	4.752	1	4.752	4.938	029
Residual	70.248	73	.962		
Total	75.000	74			

Chart VI

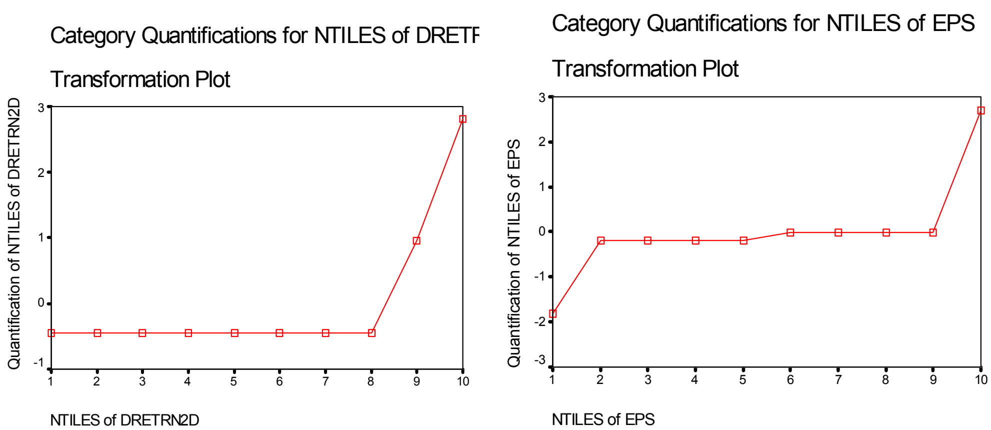
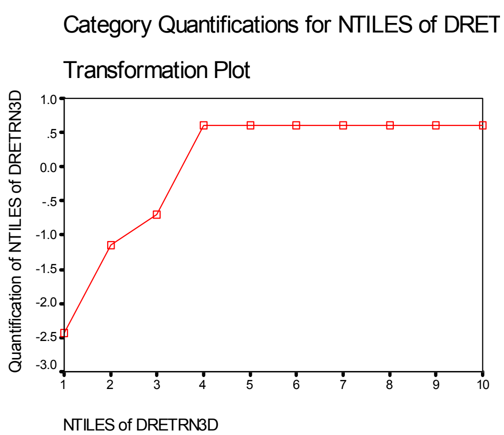


Table VIIIc shows stocks with a daily decrease greater than 10%, a regression model for 1-day deciles of return and their deciles of EPS. The regression model is significant at a 99% confidence level, which means the regression model is valid. The R square of 0.103 indicates the model explains 10.3% of the 3-day returns. In Chart VII, the deciles of 3-day return (shown in chart as Dretrn3D), the rescaling of 3-day return shows three important levels, a lowest level of the first deciles, a middle level for second and third decides, and a high level for fourth to tenth deciles. For EPS, it also shows 3 important levels, a lowest level for the first to third deciles, a middle level for fourth to ninth level, and a high level for the top deciles. And these different levels in 2-day return are correlated to the counterpart levels in EPS.

Table VIIIc stocks with a daily decrease greater than 10% --A regression model for their deciles of 3-day return and deciles of EPS					
Model Summary					
Multiple R		R Square		Adjusted R Square	
.320		.103		.090	
ANOVA					
	Sum of Squares	df	Mean Square	F	Sig
Regression	7.697	1	7.697	8.348	005
Residual	67.303	73	.922		
Total	75.000	74			

Chart VII



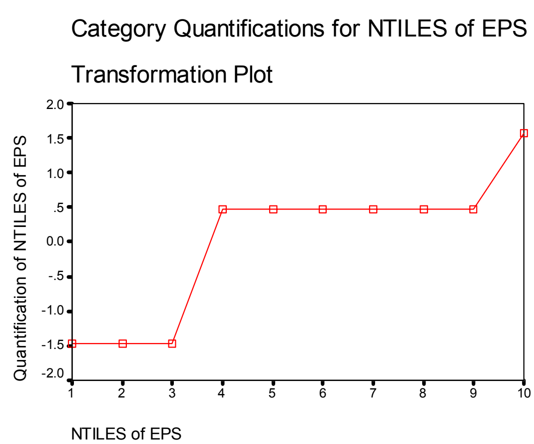
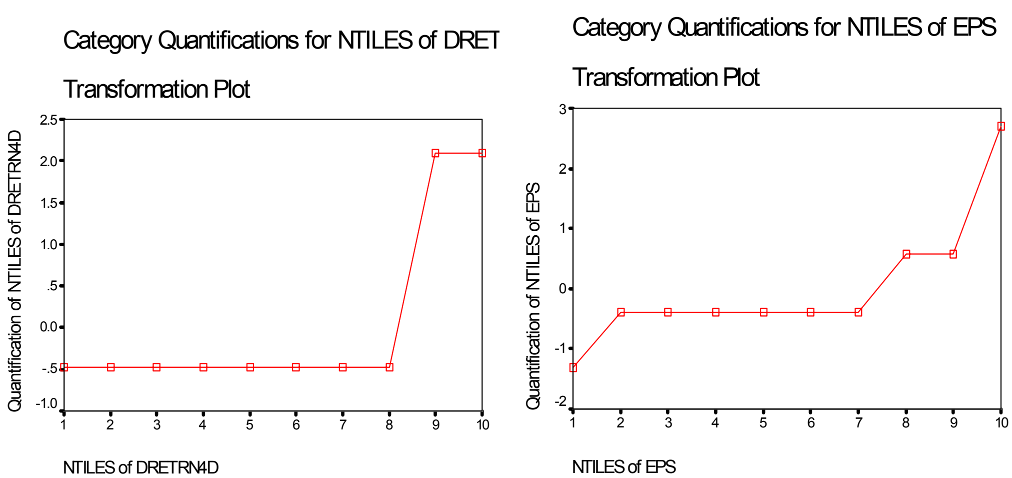


Table VIIId shows stocks with a daily decrease greater than 10%, a regression model for 1-day deciles of return and their deciles of EPS. The regression model is significant at a 99% confidence level, which means the regression model is valid. The R square of 0.134 indicates the model explains 13.4% of the 4-day returns. From the Chart VIII the rescaling of 4-day return (shown in chart as Dretrn4D) shows two important levels, a lower level of first to eighth deciles, and a high level for ninth to tenth deciles. For EPS, it also shows 2 important levels, a lowest level for the first to ninth deciles and a high level for the top deciles. And these different levels in 2-day return are correlated to the counterpart levels in EPS.

Table VIIId stocks with a daily decrease greater than 10% --A regression model for their deciles of 4-day return and deciles of EPS					
Model Summary					
Multiple R		R Square		Adjusted R Square	
.366		.134		.122	
ANOVA					
	Sum of Squares	df	Mean Square	F	Sig
Regression	10.022	1	10.022	11.260	001
Residual	64.978	73	.890		
Total	75.000	74			

Chart VIII



DISCUSSION AND IMPLICATIONS

The above results show that stocks which have a daily increase exceeding 10%, will generate overall negative returns. This could be explained by the Efficient Market Theory; price has effectively reflected their price when there is information available. So, in the first day of dramatic increase, stocks have truly reflected their price.

On the other hand, stock speculations with daily decreases more than 10%, will generate overall positive returns, and furthermore, return in the following day after the dramatic decrease will give the highest returns. This phenomenon can be explained by the investing rule of buy low and sell high in the bull markets. Once the investors see the stocks price drop, the investors believe the market will go up in the future. Investors will try to buy the stocks at the low price, in which they believe the stock prices will rise soon. Therefore, the stock price should rise after a sharp decrease.

The relationship between EPS and the returns, from Table III in the Finding and Analyses Section, indicates for stocks with a daily increase greater than 10%, investing in the stocks with positive EPS should give a better return than those with a negative EPS. Further statistics also show in Table V, Table VIIa, VIIb, VIIc, and VIId, that there is a significant correlation between the EPS and the returns. It can be expressed in the regression model: R= EPS + e. This finding gives an important indication for investment during the Bull market. When speculating in stocks under such a scenario, the EPS should be an important indicator. If the stocks have a positive EPS, the returns it generates under such a scenario should be more favorable.

In stocks with a daily decrease greater than 10%, both with negative EPS and positive EPS, there is not enough statistical evidence that the returns will favor either side. This could be explained by the Expectation Theory and the rule of buy low, sell high. In the Bull market, investors' expectation for the future markets are bullish, and they will arbitrarily buy those stocks that have gone down, with the expectation that they will go up and profit from it soon. Therefore, the Expectation Theory dominates the others. Under this investing scenario, no matter how good or bad the stocks are, investors will buy low and sell high.

This paper shows the correlation between 1-day return, 2-day return, 3-day return, 4-day return of stocks with a daily decrease greater than 10%, and their EPS are not significant in Table VI. However, in Regression Optimal Scaling, Table 8.1, 8.2, 8.3 and 8.4, it shows that the correlation between 1-day return, 2-day return, 3-day return, 4-day return, and the EPS are significant. Regression Optimal Scaling examines the underlying metrics of data gathered from different a priori known populations; it is a much more complex model than Correlation. Regression Optimal Scaling considers the underlying metrics of the data. The output covers dimensions and areas that Correlation does not . Therefore, the Regression Optimal Scaling results should prevail under the contradicting situation.

LIMITATIONS AND APPLICATION

This paper assumes that the stock buy and sell orders can be executed at a specific time. That is, buying the day after a daily increase or decrease greater than 10% in daily stock price and then selling right after1-day, 2-day, 3-day or 4-day. Also, this paper assumes that there is no transaction fee incurred during the buy and sell. Investing in stocks with a daily decrease more than 10% in a bull market, the next day will generate the overall highest daily return of 2.948%. If annualized to the 260 days for Exchange Index working days, it yields a 766.48% return in a year. This scenario might be very profitable, yet it is also very risky as well.

SUMMARY AND CONCLUSION

When speculating in stocks in a bull market, stocks with a daily increase or decrease greater than 10% would be preferable as the following day's purchase should give the overall best returns. Additionally, the selection should include a review of their EPS, because the EPS is related to the stock's performance. Generally, speculating in the stocks with daily dramatic increase more than 10%, a positive EPS stocks will have a better overall return than those with a negative EPS.

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CAN TRADING ON FEDERAL FUNDS RATE CHANGE ANNOUNCEMENTS PRODUCE ABOVE NORMAL STOCK MARKET RETURNS?: A TEST OF MARKET EFFICIENCY

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ABSTRACT

Efficient market theory contends that investors are unable to make an above normal return by trading on public information. Can an investor earn an economic profit in the stock market by trading on the basis of Federal Reserve (Fed) rate change announcements? The purpose of this study is to determine whether the announcement of a federal funds rate target change affects stock prices in the short run (5 to 30 days after the announcement). Over the period 1988 to 2007 results show a statistically significant negative correlation between target federal funds rate changes and the S&P 500 index in the short run. Regression results suggest that changes in the federal funds rate target appear to stimulate opposite changes in the 5-day, 10-day, and 30-day post announcement returns. Evidence shows that the strategy of purchasing the S&P 500 market index on the announcement of a federal funds target rate cut can yield 5-day, 10-day, and 30-day post announcement excess returns. Results also confirm that negative correlation between target federal funds rate changes and the S&P 500 index significantly decreased as periods of time following a rate change increased. This study suggests that the market is not efficient with respect to announcements of Federal Funds rate changes in the short term.

INTRODUCTION

Macroeconomic theory suggests that changes to the federal funds rate target (FFRT) should related negatively to stock prices. How fast does the stock market react to FFRT change announcements? Efficient market theory claims that no investor can earn an above normal return by acting on publicly available information. Instead, the market reacts so fast to all public announcements that no investor can beat the market by a trading rule that uses such information. It follows that public announcements of FFRT changes should not stimulate significant stock market price reactions. However, evidence here identifies significant short term rallies following a FFRT cut allowing an investor to earn an above normal return by purchasing a Spider (an investment in the S&P 500 index) and holding it for a short period following a FFRT change announcement. A possible explanation to this and other efficient market anomalies is offered by recent behavioral finance literature suggesting that the stock market can be strongly influenced by investor emotion and other non-rational phenomena keeping stock out of equilibrium for short periods of time.

The purpose of this study is to determine whether the announcement of a FFRT change affects stock prices in the short run in a manner that would allow an investor to earn an above normal return by following a trading strategy based on such information. If FFRT changes are highly correlated with stock price movement, the opportunity to earn an above normal return may exist in contradiction to efficient market theory. This study tests the efficient market hypothesis using FFRT changes and S&P 500 market data from 1988 to the present. We hypothesize that FFRT changes generate negative short term effects on the market. These are likely more pronounced during economic declines when the Fed is cutting rates. As the economy slows, the Fed generally attempts to soften a recession landing by increasing the money supply to effectively reduce interest rates. We hypothesize that when rates are cut, there is a short-term above average jump in stock prices that allows an investor to earn an above normal return by acting on the rate change announcements.

LITERATURE REVIEW

Fama (1970, 1976) defined market efficiency in three forms: weak-form, semi-strong-form and strong-form market efficiency. Weak-form efficiency deals with the notion that no investor can earn an above economic return by developing trading rules based on past price or return information. Numerous studies (Fama, 1965; Alexander, 1961; Fama and Blume, 1966; Granger and Morgenstern, 1970) support the random walk theory in support of weak form efficiency. Semi-strong-form market efficiency states that no investor can earn an above economic return based on any publicly available information. Tests of semi-strong form efficiency (Fama, Fisher, Jensen, and Roll, 1969; Ball and Brown, 1968; Aharony and Swary, 1980, 1981; Joy, Litzenberger, and McEnally, 1977; Watts, 1978; Patell and Wolfson 1984; Scholes, 1972; Kraus and Stoll, 1972; Mikkelson and Partch, 1985; Dann, Mayers, and Raab, 1977) document the claim that no investor can earn an above normal return on publicly available information such as accounting statements, stock splits, dividend announcements, sale of stock announcements, repurchase of stock announcements, block trades, and earnings announcements.

Strong-form efficiency theory suggests that no investor can earn an above economic return from using any information, public or private. Studies on the validity of strong form efficiency offer mixed results (Jaffe, 1974; Finnerty, 1976; Givoly and Palmon, 1985; Friend, Blume, and Crockett, 1970; Jensen, 1968). A large body of literature cites numerous anomalies that question market efficiency theory. Researchers that have explored these types of discrepancies include: Reilly and Hatfield, 1969; Stickney, 1970; McDonald and Fisher, 1972; Logue, 1973; Stigler, 1964; Shaw, 1971; Loughran and Ritter, 1995, Bray and Gompers, 1997; Mitchell and Stafford, 1997; Lowrey and Schwert, 2002; Weinstein, 1978; Grinblatt, Masulis, and Titman, 1984; Foster and Vickery, 1978; Woolridge, 1983; Copeland, 1979; Ohlson and Penman, 1985; Brennan and Copeland, 1988; Dharan and Ikenberry, 1995; Ikenberry, Rankine, and Stice, 1996; Fama, 1998; Mitchell and Stafford, 1997; Black, 1971; Copeland and Mayers, 1982; Chen, Copeland, and Mayers, 1987; Stickel, 1985; Lakonishok and Vermaelen, 1990; Ikenberry, Lakonishok, and Vermaelen, 1995; Mitchell and Stafford, 1997; Friend and Vickers, 1965; Sharpe, 1966; Treynor, 1965; Farrar, 1962; Friend, Blume, and Crockett, 1970; Jensen, 1968; Mains, 1977; Henricksson, 1984; French, 1980; Dyl, 1973; Branch, 1977; Keim, 1983; Reinganum, 1983; Roll, 1983; Gultekin and Gultekin, 1983.

This academic camp providing documentation of anomalies questioning market efficiency adheres to what has recently become known as the behavioral challenge to market efficiency. That is, not all investors are rational, a critical assumption underpinning the behavior necessary to make the market efficient. Many investors buy, not necessarily when the stock price is below its economic value, but when they get their tax refund and sell to raise money for a down payment on a car. Many overact based on too few observations driving stock price either down too low or up too high for extended periods of time. The bubble in internet stocks in the 1990s is an example. Likewise, others are too conservative, motivating them to delay their reaction to valid economic information too long resulting in holding winners and losers too long. They appear to develop an emotional attachment to a position in their portfolio and hold on too long in the face of significant positive or negative news. These psychological behavioral patterns could explain the numerous anomalies cited above and also apparent in the findings of this study. For a complete review of the behavioral conditions that impact market efficiency, see Shleifer (2000).

The literature offers a wealth of evidence both supporting and contradicting efficient market theory. But, most of the research agrees that the market is at least weak-form efficient with respect to past information. Therefore, no investor should earn an above normal return in the days and weeks following a FFRT change announcement. If so, then the work here can add to the body of knowledge that calls into question market efficiency theory.

METHODOLOGY

To test the relationship between FFRT changes and stock price, we observe FFRT changes over the period from January 1988 to September 2007. During this 20 year period there were 87 FFRT changes, 45 negative and 42 positive. The S&P 500 market index is used as a proxy to represent the stock market. To test the relationship between FFRT and stock price, we employ the following null and alternate hypotheses:

H_o: From 1988 to 2007, there is no statistically significant negative relationship between FFRT changes and the S&P 500 index in the short run.

H_a: From 1988 to 2007, there is a statistically significant negative relationship between FFRT changes and the S&P 500 index in the short run.

Data for the 87 FFRT changes and corresponding S&P 500 closing values for the time period 1988 to 2007 were collected. Following each of the 87 FFRT changes, short term changes in the S&P 500 were calculated. Post announcement holding period returns (HPRs) of the S&P 500 index were calculated using the following formula: Holding period return = (end of period close price – beginning of period close price)/beginning of period close price.

Holding period returns were calculated subsequent to the FFRT change for 5-day, 10-day, 30-day periods, and for the entire interval of time before the FFRT changed again. For example, if the Fed announces a rate change on day 0 and another rate change on day +200, we calculated the 5-day, 10-day, 30-day, and 200-day HPRs for the S&P 500 market index following announcement day 0. We collected over 4937 observations of the 87 FFRT changes and the S&P 500 market index over the 20 year study period. We then regressed the HPR data against the FFRT changes to test the hypotheses using ordinary least squares linear regression as follows: $S\&P\ HPR_{Time\ Interval} = \alpha + \beta(\%\ FFRT) + \epsilon$ where the independent variable = % FFRT change; dependent Variable = S&P 500 HPR for time interval after announcement; α = alpha or Y intercept; β = beta or relationship between change in HPR and change in FFRT; and ϵ = error term.

Four regressions were conducted using the percentage changes in the FFRT as the independent variable and the 5-day, 10-day, 30-day, and the time-between-rate-changes HPRs as the corresponding dependent variables. Also, we computed the post announcement arithmetic 5-day, 10-day, and 30-day HPR means for: the sample of 45 FFRT cuts; all 87 FFRT changes; and for all possible consecutive 5-day, 10-day, and 30-day HPRs over the 20 year period. To determine excess returns the corresponding means for the sample of FFRT cuts were then compared to the overall average 5-day, 10-day, and 30-day HPRs of the S&P 500 for entire sample of 87 FFRT changes and to the mean HPRS for all possible consecutive 5, 10, and 30-day HPR means for the S&P 500 over the entire 20-year period.

QUANTITATIVE TESTS AND RESULTS

Data analyzed include all 87 FFRT changes from January of 1988 to September 2007. Table 1 summarizes the regression results. The data support the alternate hypothesis.

Table 1. Regression Results for 87 FFRT Change Announcements

Period After Announcement	Alpha Coefficient	Beta Coefficient	Correlation Coefficient	P-Value	F-Value
5-Day	0.001402	-1.94896**	-0.25937	.0145	6.22
10-Day	0.002947	-1.59028**	-0.18629	.0694	3.38
30-Day	0.11191	-1.379	-0.08304	.4301	0.63
Until Next Rate Change	0.021868	.698257	0.02997	.784155	0.07

**Significant at the 95% level of confidence

Table 1 shows that as the length of the HPR time interval increases, the strength of the linear regression weakens. The P-values for significance rise as the time interval increases suggesting greater potential for excess return the shorter the time period after the announcement. The 5-day return shows the greatest significance almost at the 99% confidence interval. Likewise, the 10-day return tested significant at the 95% level. F-values decrease as the holding periods increase suggesting that after a rate change is announced, a linear relationship with market return decreases as the time interval increases. As expected, the correlation coefficients (all negative as expected for the 5, 10, and 30 day intervals) move closer to zero as the time lapse after the announcement increases.

The regression beta coefficients suggest that changes in the FFRT stimulate opposite changes in the 5-day, 10-day, and 30-day post announcement HPRs. And the statistical significance of this relationship declines as the HPR time interval increases providing support for short-term effect of the announcement.

Table 2. S&P Mean HPRs Over the 20 Year Time Period

	A	B	C		
Time Interval	Mean HPR for 45 negative rate	Mean HPR for all 87 rate changes	Mean HPR-all consecutive intervals	EXCESS RETURN A-B	EXCESS RETURN A-C
5-day	0.774%	0.179%	0.20%	.595	.574
10-day	0.772%	0.327%	0.394%	.445	.378
30-day	2.159%	1.147%	1.185 %	1.012	.974

Table 2 shows the mean of short term S&P 500 HPRs for: the sample of FFRT cuts; the entire sample 87 FFRT changes; and for all possible consecutive 5-day, 10-day, and 30-day HPRs over the 20 year period. As shown, the sample of FFRT cuts produced the highest 5-day, 10-day, and 30-day HPRs. Mean HPRs for the sample of FFRT cuts exceeded all corresponding mean returns for the entire sample of 87 FFRT changes (Column A-B) and for the sample of all possible consecutive mean returns (Column A-C). For example, the mean HPR of all 87 5-day post announcement intervals was 59.5 basis points under the corresponding 5-day post announcement HPR for the sample of 45 FFRT cuts. The mean HPR for all possible consecutive 5-day intervals over the 20 years was 57.4 basis points under the corresponding mean of sample of 45 FFRT cuts. Excess returns for the 10 and 30-day intervals for the FFRT cut sample ranged from around 39 to 101 basis points. These results further confirm the substantial short-term reaction of the market to Fed funds rate target changes.

CONCLUSION

Efficient market theory contends that investors are unable to make an above normal profit based on information that is readily available to the public. However, the evidence here suggests numerous rallies following a Fed rate cut. The purpose of this study was to determine whether the announcement of a FFRT change affects stock prices in the short run (5 to 30 days after the announcement) in a manner that would allow an investor to earn an above normal return by following a trading strategy based on such information. Over the period 1988 to 2007, results show a statistically significant negative correlation between target federal funds rate changes and the S&P 500 index in the short run. Regression results suggest that changes in the federal funds rate target appear to stimulate opposite changes in the 5-day, 10-day, and 30-day post announcement returns. Evidence shows that the strategy of purchasing the S&P 500 market index on the announcement of a federal funds target rate cut can yield 5-day, 10-day, and 30-day post announcement excess returns. Results also confirm that negative correlation between target federal funds rate changes and the S&P 500 index significantly decreased as periods of time following a rate change increased. This study suggests that the market is not efficient with respect to announcements of Fed funds rate changes in the short term. Results here question the strength of market efficiency and may offer additional evidence in support of the behavioral challenge to efficient market theory (Scheifer, 2000).

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BELIEF ADJUSTMENT IN THE BUDGETING PROCESS: EXAMINING THE CONTEXTUAL VALIDITY OF THE BELIEF-ADJUSTMENT MODEL

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ABSTRACT

We present the results of our examination of the contextual validity of the Hogarth and Einhorn (1992) belief-adjustment model when applied to a managerial accounting concern – the reliability of the sales forecast component of the annual budget. The contrast effect is observed as predicted by the model. However, the recency order effect predicted for a mixed message does not obtain when external factors such as pre-task attitude of the decision maker and source credibility are introduced. We conclude that contextual factors need to be considered when predicting order effects.

INTRODUCTION

Maines, Salamon and Sprinkle (2006) note that experimental research has played an important role in accounting research for over 40 years. This research is distinguished from other forms of empirical accounting research by the method employed (experiment versus archival/survey/field study) and often by supporting theory (e.g., psychology versus economic). Maines et al. (2006, p. 86) state, "the objective of accounting research is to create legitimate, consequential belief revision about issues associated with accounting-related decision settings."

Identifying strongly with this goal, in this study we adopted an experimental approach to examine belief revision in an accounting-related decision setting. Specifically, this paper presents the results of our examination of the validity of Hogarth and Einhorn's (HE) belief-adjustment model, "a descriptive theory of belief updating that can be applied to many substantive domains" (Hogarth & Einhorn, 1992, p. 2), when applied to an important accounting decision – the setting of the sales forecast component of the annual operating budget.

The HE belief-adjustment model provides a framework for developing expectations concerning order effects that may bias sequential information processing within judgment and decision-making tasks. The effects of order have been shown to be dependent upon such variables as message length, decision complexity, and number of messages (Hogarth & Einhorn, 1992). These variables are all embedded within the task and do not consider such external variables as pre-task attitude of the decision maker or the reliability of the information being processed. This research tests whether the order and contrast effects predicted by the HE belief-adjustment model obtain given such factors that are external to the task variables previously identified within the model.

BUDGETING AND THE BELIEF-ADJUSTMENT MODEL

Budgeting is a judgment and decision-making (JDM) process. As a mechanism for the allocation of corporate resources, budgeting is central to the stewardship and control functions of corporate accounting managers. To fulfill these functions, the budgeting process relies on information conveyed to the decision-maker who processes it and consequently revises a prior belief. This study examines the setting of budget variables as a JDM process where the decision-maker (under varying compensation schemes) relies on the communication of information from sources of varied credibility. The decision process is modeled as an anchor and adjustment process using the HE belief-adjustment model, and the model is then tested for contextual validity.

The HE belief-adjustment model outlines a framework showing how task variables and processes interact in producing order effects in belief updating. This model was developed to determine the conditions that lead to order effects (primacy or recency) in the belief updating process. The model predicts recency effects when the task is complex and evidence is mixed (a combination of positive and negative messages), which is the scenario modeled in our experiment. Recency has been shown to occur for relatively long (Petty & Cacioppo, 1986b) as well as short series involving mixed evidence (Bamber, Ramsay & Tubbs, 1997). More recently, the HE belief-adjustment model has been used to explain auditors' attitudes towards the evidence in the going concern evaluation (Guiral & Esteo, 2006) and investor reactions to the joint effects of dividend and earnings surprises (Hartono, 2004).

Adapting from the methodology used in Bamber et al. (1997), we use the HE belief-adjustment model to measure and contrast subjects' weighting of sales-increasing and sales-decreasing messages when estimating the sales variable for the operating budget. Bamber et al. (1997) used the HE belief-adjustment model as a framework to examine auditors' sensitivity to evidence. The results provide support for the HE belief-adjustment model and suggest that auditors are more sensitive to confirming than disconfirming evidence. A predicted recency order effect was observed. This study extends the Bamber et al. (1997) study by testing for the descriptive validity of the HE belief-adjustment model in another context - a budget task - by examining the evaluation and integration of budget information in the budget decision process.

Three independent variables – message direction, compensation scheme, and source credibility – are manipulated within a sales forecasting budget task, and the resulting subject responses are analyzed. The findings of prior research indicate that, in an uncertain and complex decision environment, decision-makers may use heuristics (mental shortcuts) that lead to sub-optimal decisions (Tversky & Kahneman, 1974 & 1981; Hogarth, 1987; Ashton & Ashton, 1988). Agency research finds that agents may bias budget decisions and that compensation contracts are a key component within the decision environment (Chow, 1983; Frederickson, 1992; Shields & Waller, 1988; Waller & Chow, 1985; Young, 1985). Moreover, outcomes of the budgeting process often include the exchange of information between interactants, leading to potential biases due to the credibility of the information source and the perceived importance of the information to the decision-maker (Petty & Cacioppo, 1986a; 1986b).

Prior studies have also shown that individuals are inclined to evaluate evidence in a way that confirms their existing beliefs by assigning more importance to pro-attitudinal (confirming) evidence (Church, 1990; Lord, Ross & Lepper, 1979; McMillan & White, 1993). In this study, management compensation schemes are manipulated to induce contrasting initial attitudes toward upward and downward revisions in forecasted sales. The source credibility manipulation provides both relatively weaker and stronger messages based on the credibility of the message source.

We examine whether the order and contrast effects predicted by the HE belief-adjustment model obtain when the experimental conditions include a pre-task manipulation of attitude toward pertinent information (through the manipulation of compensation scheme) as well as whether order effects are more or less prevalent depending on the strength (source credibility) of the message received. Message direction is manipulated to simulate the "mixed message" condition of the HE belief-adjustment model. Specifically, we observe how MBA student subjects (acting as incentive-based sales executives performing a budget task) adjust their estimates of projected annual sales when given uncertain, mixed-direction information (both sales-increasing and sales-decreasing) from either high or low credibility (a between-subjects manipulation) sources.

EXPERIMENTAL DESIGN

The design for this study is a 3 (compensation scheme – high goal, low goal, and control) x 2 (high or low credibility source) x 2 (order – sales-increasing message precedes sales-decreasing message and vice versa) between-subjects design, with message direction manipulated within subject. The subjects are MBA students enrolled in at a large public research university. A total of 142 subjects participated in the experiment. Subjects are randomly assigned to treatment groups. A copy of the research instrument may be obtained by request from the authors.

Independent Variables

Three independent variables are manipulated between subjects - compensation scheme, source credibility, and message order – in order to examine and isolate their potentially biasing effects on the budget decision. The effects of these variables on the decision process are determined by measuring the differences in adjustments to the sales forecast made by the subjects. Adjustments to the sales forecast are expected to vary between subjects based upon the level of the independent variables and their patterns of interaction. A fourth independent variable, message direction, is manipulated within subjects and provides a "mixed message" scenario; each subject evaluates both a sales-increasing and a sales-decreasing message.

Compensation for participation in the experiment is varied at three levels: a fixed compensation scheme ("control group"), an incentive-based compensation scheme that favors a higher sales forecast ("high goal" group), and an incentive-based compensation scheme that favors a lower sales forecast ("low goal" group). Three levels were chosen in order to operationalize the incentive-based compensation scheme in opposing directions as well as provide for a control group.

As in prior research (Bamber et al., 1997), source credibility is varied at two levels. Specifically, messages are received from either two high credibility sources and or two low credibility sources. Credibility is related to perceptions of both source expertise and source trustworthiness (Bamber et al., 1997).

Message order is varied by presentation of either the sales-increasing message first followed by the sales-decreasing message or vice versa. After controlling for the other independent variables, message order becomes the focal point of interest when testing the validity of the HE belief-adjustment model.

Experimental task

The budget decision examined in this study is focused on the setting of the sales forecast variable. The sales forecasting task was chosen because it is the fundamental starting point in budgeting and consequently a critical decision. The decision process is modeled as an anchor-and-adjustment process. Specifically, this study analyzes the integration of information provided as an anchor with supplemental information obtained in two sequentially processed messages that are directionally opposed (one sales-increasing message and one sales-decreasing message).

The subjects are introduced to the task and informed of their compensation for participation. Then, acting as sales executives, they are asked to estimate a value for next year's sales for a fictitious company. Subjects first receive an aggregation of the district sales managers' sales forecast. The district sales managers' aggregated forecast acts as the anchor, or initial belief. Next, subjects receive two additional pieces of information that relate to next year's sales. The two additional pieces of information are received as messages from various sources, both within and outside the company. Subjects are asked to update the sales forecast after the receipt of each message. Three beliefs concerning the sales forecast are thereby gathered from the subjects: the initial belief (anchor), the first belief adjustment (recorded after evaluating the first message), and the second belief adjustment (recorded after evaluating the second message). When combined with the sales forecast provided by the district sales managers, the messages suggest either an upward or a downward revision in the forecast. The messages all contained uncertain information; the information provided is stated as a range rather than a point estimate, and therefore contained uncertainty regarding the precision of the estimates. This uncertainty allows subjects to make biased revisions to the sales forecast by choosing higher or lower points within the range of estimates. At the conclusion of the experimental task, subjects are asked to complete a questionnaire that captures demographic information (age, gender, work experience, budgeting experience, accounting coursework, level of current position, and undergraduate field of study).

RESEARCH METHODOLOGY

The HE belief-adjustment model predicts recency effects when the task is complex and evidence is mixed (a combination of positive and negative messages). Each new piece of information is evaluated as positive or negative relative to the original belief (the starting point). The HE belief-adjustment model is specified as follows for the evaluation mode:

$$S_k = S_{k-1} + w_k s(x_k \quad (1)$$

where

S_k is the adjusted belief after k pieces of evidence,
S_{k-1} is the anchor or prior belief,
w_k is the adjustment weight for the kth piece of evidence,
$s(x_k)$ is the subjective evaluation of kth piece of evidence.

The adjustment weight (w_k), or "contrast effect," states that the adjustment weight depends on both the direction of the impact of the evidence and the level of the anchor or prior belief (S_{k-1}). The adjustment weight is proportional to the strength of the anchor or prior belief when evidence is disconfirming and inversely proportional when evidence is confirming. If belief is strong (on either the positive or the negative side) and strong confirming evidence is received, there is a larger adjustment than if belief is weak (on either the positive or the negative side) and strong disconfirming evidence is received.

In this experiment, subjects were asked to provide adjustments to their initial belief after receiving additional information. The effects of the independent variables on the decision process were determined by measuring the differences in adjustments to the sales forecast made by the subjects. Adjustments to the sales forecast were expected to vary between subjects based upon the level of the independent variables and their patterns of interaction.

RESULTS

Data obtained in this study are analyzed to test for the presence of order effects and the contrast effect assumed by the HE belief-adjustment model. The HE belief-adjustment model predicts order effects due to the sequential processing of information. The test for order effects examines whether the order in which the subjects received the two messages made a difference in the amount of belief adjustment. There are six between-subjects cells in the design - three compensation groups and two levels of source credibility. Within each of these cells, the subjects received both a sales-increasing and a sales-decreasing message. For every other subject, the order in which the messages were received was reversed so that half of the subjects evaluated an increasing message first while the other half evaluated a decreasing message first. This study tested the HE belief-adjustment model prediction that the last message received would be more influential (cause a larger change in belief) than the first, all other things being held constant. The dependent variable is amount of belief change, irrespective of sign (absolute value).

An ANOVA was run with the absolute value of the belief revision, $|S_k - S_{k-1}|$, as the dependent variable and compensation group, order, message direction, and source credibility as the independent variables, as well as their interaction terms. Bamber et al. (1997) used this method of testing for a recency effect. The message direction by order of evidence interaction is significant ($F(1,259) = 5.66$, $p = .0181$), lending support to an order effect. Evidence of order effects in the budget judgment decision-making process suggests the introduction of a cognitive bias that could lead to sub-optimal resource allocation. Table 1 breaks down the interaction term and presents the differences in means for each message type in both order positions. T-tests were conducted to determine differences in means among the various cells in the table.

Table 1: Absolute Value of Mean Belief Revision

Panel A: High and low credibility sources combined				
Message	Order of Evidence		Effect	p-value
	Incr/Decr	Decr/Incr		
Increasing	8165	7181*	n.s.	0.42
Decreasing	6866*	10257	primacy	0.02
Panel B: High credibility sources only				
Message	Order of Evidence		Effect	p-value
	Incr/Decr	Decr/Incr		
Increasing	10301	9658*	n.s.	0.70
Decreasing	10013*	15097	primacy	0.02
Panel C: Low credibility sources only				
Message	Order of Evidence		Effect	p-value
	Incr/Decr	Decr/Incr		
Increasing	6030	4479*	n.s.	0.33
Decreasing	3719*	5132	n.s.	0.41

* Denotes messages (increasing or decreasing) in the second as opposed to the first position.
n.s. = not significant

For increasing messages, mean belief revisions are not significantly different ($p = 0.4195$) when the message is in the first as opposed to the second position (8165 versus 7181). This apparent lack of order effect, while not conclusive, is in opposition to the recency effect predicted by the HE belief-adjustment model under conditions of mixed, short-series evidence sequences. However, for decreasing messages, mean belief revisions are significantly different ($p = 0.0294$); they are larger when the message is in the first as opposed to the second position (10257 versus 6866) – a primacy effect. These findings suggest that the HE belief-adjustment model's predictions of order effects due to sequential information processing may not hold under conditions where an initial attitude precedes the decision process. The anticipated recency effect may be mitigated or even reversed when subjects enter the decision process with a pre-existing bias due to a linkage between the budget decision and their compensation.

The HE belief-adjustment model also contends that the recency effect will be larger given stronger evidence (in this study, given higher source credibility). The means were segregated by source credibility to determine whether a recency effect was masked when source credibility means were aggregated. As shown in Table 1, a somewhat different pattern emerges between high and low credibility sources when the means are segregated. Again, the predicted recency effect does not obtain. However, the primacy effect observed in the combined data for decreasing messages is no longer significant when the message is received from a low credibility source ($p = 0.4136$). A conservatism bias may make messages from low credibility sources more salient, resulting in a more careful examination of the information. The increase in cognitive effort may tend to overwhelm the order effect that is observed when messages are received from a high credibility source.

Test of the Contrast Assumption

Another key feature of the HE belief-adjustment model is the contrast assumption which states that negative evidence induces greater belief change the larger the preceding anchor; for positive evidence it is the reverse. Therefore, the "contrast effect" assumes that adjustment weight depends on both the sign of the impact of the evidence and the level of the anchor or prior belief (S_{k-1}). For mixed evidence (in this study, a sales-increasing message is followed by a sales-decreasing message, or vice versa), the second message will induce more belief change when processed after evidence that is opposite in sign. This follows from the fact that positive evidence that is processed in a negative-positive order has a lower prior belief than when processed in a positive-negative order. Likewise, negative evidence processed in a positive-negative order has a larger prior belief than when processed in a negative-positive order (Hogarth & Einhorn, 1992).

Significant correlations between the prior belief and the change in belief after the second message confirm the implications of the contrast assumption for mixed evidence. Table 2 presents the results of the correlation test of the contrast assumption.

Table 2: Correlation Test of contrast Assumption

Correlation between	Increasing followed by decreasing message	p-value
S_1 and (S_1 -- S_2)	0.26483	0.0246
S_1 and (S_1 -- S_2)	0.37808	<0.0013

DISCUSSION

Hogarth and Einhorn (1992) suggest that, while the belief-adjustment model provides a framework for predicting order effects, further research is needed to determine how roles and incentives might affect differential sensitivity to negative and positive evidence.

This study finds that roles and incentives do have an impact on subjects' sensitivities toward sales-increasing (positive) and sales-decreasing (negative) messages in the budgeting context. The HE belief-adjustment model predicts a recency order effect for mixed messages. However, this study finds that the HE belief-adjustment model's predictions of order effects due to sequential information processing may not hold under conditions where an initial attitude precedes the decision process. The anticipated order effect may be mitigated or even reversed when subjects enter the decision process with a pre-existing bias due to a linkage between the budget decision and their compensation. This suggests that the HE belief-adjustment model, while descriptive of sequential information processing under some conditions, may not accurately predict order effects when the decision-maker is biased by economic incentives. This study's results suggest that order effects may be overwhelmed by other biases.

The HE belief-adjustment model also incorporates a "contrast effect" as an underlying assumption of the model. The contrast assumption predicts that belief change will be proportional (for negative messages) or inversely proportional (for positive messages) to the current anchor (the belief preceding the new message). A positive finding for the contrast effect implies that the budgeting decision task may be biased if an anchor-and-adjustment process, including the contrast effect, is descriptive of the budget decision-making process. The amount of belief change upon review of new information may be affected by the strength of the current belief (current anchor) and the direction of the new information. As stated by Hogarth and Einhorn, large anchors are "hurt" more than smaller ones (given the same negative evidence). (Hogarth & Einhorn, p.14) The experimental findings support the validity of this assumption.

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