The use of selected economic indicators in regression analysis to test semi-strong market efficiency of asset pricing

Kevin E. Pearson
University of Northern Iowa

Follow this and additional works at: https://scholarworks.uni.edu/pst

Let us know how access to this document benefits you

Recommended Citation
https://scholarworks.uni.edu/pst/122

This Open Access Presidential Scholars Thesis is brought to you for free and open access by the University Honors Program at UNI ScholarWorks. It has been accepted for inclusion in Presidential Scholars Theses (1990 – 2006) by an authorized administrator of UNI ScholarWorks. For more information, please contact scholarworks@uni.edu.
Kevin E. Pearson

UNI Presidential Scholar
Senior Thesis Project:
The Use of Selected Economic Indicators
in Regression Analysis to Test
Semi-Strong Market Efficiency
of Asset Pricing

Advisors:
Dr. Lyle L. Bowlin
Department of Finance
Dr. Fred Abraham
Department of Economics

April 24, 1991
The Use of Selected Economic Indicators in Regression Analysis to Test Semi-Strong Market Efficiency of Asset Pricing

The concept of market efficiency is a widely known and researched concept. The profit motive present in the market combined with advancements in trading technology and company knowledge have practically eliminated mispricing in equity markets. However, the limited number of hours of trading present in stock exchanges of the United States generates the potential for a certain amount of inefficiency. This inefficiency results from the inability of various stock markets to process certain types of public information because of the timing of its arrival in relation to the operating hours of the market. This paper will outline the process followed to investigate this concept and then describe the future implications of technological and deregulatory trends. Specifically, this paper will:

-- explain the concepts of stock market price behavior and the three forms of market efficiency,
-- describe the research process used to develop the model, research the stocks and economic indicators, and how they were used to develop statistical results,
-- define the concepts involved in multi-variate linear regression and describe the meaning of the resulting variables,
-- analyze inefficiencies in the context of the how the economic variables relate to the stock market,
-- project developments in the structure of stock markets and the implication for market efficiency.

Concepts of Stock Market Price Behavior and Market Efficiency

The stock market is one of the most accurate practical examples of the effect of supply and demand on price. In a market there are potential buyers (demanders) and
potential sellers (suppliers) for a certain stock. The process of matching buyers with sellers is facilitated by different methods in different markets. For example, at the New York Stock Exchange, there are market specialists that control the trading in certain stocks (Alexander and Sharpe 36). If there is a difference between the amount demanded and supplied on a certain stock, the specialist can either buy or sell from his or her personal account or can make different price quotes which, in other words, would adjust the price of the stock. These two methods are used to achieve an equilibrium price and keep order in the market (Figure 1). For smaller over the counter stocks, there is no central market, but rather a network of securities dealers trading through the computerized NASDAQ (National Association of Securities Dealers Automated Quotation) system. There is no specialist controlling trades. It is completely left up to individual dealers to buy low and sell high through the computer. If they try to sell too high or buy too low they will not find the other party to a trade (Figure 1). This competition, therefore, causes an equilibrium price to be reached (Alexander and Sharpe 42). Consequently, security pricing can be seen as the interaction of a supply and demand to arrive at a price that equates the two and satisfies buyers and sellers of a stock.

The issue that follows is what factors cause supply and demand to increase and decrease for different stocks. The main factor that affects the supply and demand and ultimately the change in value of a particular stock is company related information. This information can come in three forms: company specific information, information about the industry that the company is a part of, and information about the economy. Since the value of a firm and hence its stock is determined by the present value of all expected future earnings and/or dividends of the company, how information affects these expected future earnings and/or dividends is indicative of the effect on the stock price. Hence, favorable information for either the company, industry, or economy will raise the earnings projections of investors. Demand will increase because buyers will be
willing to pay a higher price and supply will decrease because sellers will want a higher price for the stock to reflect the change in value. The converse of this is true for unfavorable information which would cause a decrease in stock price. The basic message is that information can change expectations about the success of the firm which is reflected in price changes of the underlying stock.

To what degree and how quickly stock prices react to various types of information determines the efficiency of the market. According to Alexander and Sharpe "A market is efficient with respect to a particular set of information if it is impossible to, on average, make abnormal profits using this set of information to formulate buying and selling decisions" (68). Because of the competition in the market and the availability of technology a market is typically considered efficient if it processes information within about 15 minutes of the arrival. This is the typical amount of time it takes to make a trade (Jacob's & Levy 35). There are three "particular sets" of information that result in three levels of market efficiency.

**Weak Market Efficiency** -- present prices reflect all information contained in the record of past prices

**Semi-strong Market Efficiency** -- present prices reflect all publicly available information including past stock prices

**Strong Market Efficiency** -- present prices reflect all information including privately held or insider information and all publicly available information including past stock prices (Shapiro 61).

Publicly available information is that information that is released for the use of any individual through an accessible source. Private/insider information is information not revealed to the general public and is either confidential or only available to a limited number of people. Evidence has shown that major U.S. security markets are weak-form efficient. Since the acquisition and impact of private and insider information is beyond the scope of this paper, semi-strong market efficiency is the relevant theory to be tested.
The Research Process

In order to test market efficiency, data had to be collected on security prices and economic indicators. The first step was to select a portfolio of securities. Predetermined portfolios such as the Dow Jones Industrial Average or the Standard and Poor's 500 composite were not used for two reasons. One, the companies were relatively widely held and watched and consequently adjusted too quickly to information which made them very efficient and contrary to the aims of the study. Two, these market value indicators may be used as pieces of "publicly available information" to test semi-strong market efficiency. Consequently, criteria for selecting a portfolio of securities had to be established. Since the aim of this study was to show that publicly available information could be used to predict abnormal price changes, securities that had the potential for unexpected large price increases should be selected. Such securities would be more likely to be less efficient because the unexpected nature of abnormal price changes is inconsistent with the assumptions of market efficiency that states that security prices and price changes reflect information and are expected.

Such a selection criteria is proposed by Marc R. Reinganum in his article "The Anatomy of a Stock Market Winner". In this article, Reinganum identifies nine characteristics common to 222 stock market winners whose stock price at least doubled during one year of the 1970 to 1983 period. A trading strategy using these characteristics to select stocks significantly outperformed the S&P 500 index. These results could not be explained by past price behavior which supports only weak market efficiency. In addition, Reinganum suggests that his evidence shows that well-informed investors do not predict major price advances. If true, this weakens the theory of semi-strong market efficiency and will support the aims of this study. The nine screens that Reinganum used are:

1. price-to-book ratio is less than 1.0,
2. five year growth rate based on quarterly earnings is positive,
3. quarterly earnings are accelerating,
4. pretax profit margins are positive,
5. fewer than 20 million common shares are outstanding,
6. relative strength rank is at least 70,
7. relative strength rank of the stock in the current quarter is greater than the rank in the previous quarter,
8. O'Neil datagraph rating is at least 70,
9. stock is selling within 15 per cent of its maximum price during the previous two years.

Availability of information constrained the actual criteria used in the study to:

1. price-to-book ratio is less than 1.0,
2. quarterly earnings are accelerating,
3. fewer than 20 million common shares are outstanding,
   this following criteria was also added but was optional in the final selection since they restricted the number of stocks in the study
4. five year growth rate based on quarterly earnings is positive,
5. relative strength rank is at least 70.

Value Screen, which is a computer database of 1600 stocks, was used to apply the criteria in order to select stocks used in the study. The specific criteria used included:

-- Price/Book Value < 1
-- Earnings per Share Growth in the past 5 years < 15%
-- Projected Earnings per Share Growth => 15%
   (These two criteria give stocks with accelerating earnings)
-- Less than 20 million shares outstanding.

A price to book value of less than one is significant. The price reflects the value that the market places on the firm while the book value is the actual accounting value of the equity of the firm. The ratio being less than one signifies that investors are pessimistic about the firm's prospects. However, a large projected growth rate will eventually cause the market value to rise in the future which is what Reinganum predicts. This narrowed the field of 1600 stocks down to 37 stocks shown in Figure 2. One of the stocks selected, Altos Corporation, was found in the course of the study to have gone private. In other words, all of the stock was purchased by a private group of investors and was no longer traded publicly. The stock was therefore no longer traded on the Over the Counter market and was dropped from the study.
For the other 36 stocks, daily closing price and trading volume was copied from the Wall Street Journal. In addition, various sources supplied daily data on 27 economic and market indicators listed in Figure 2. This information was collected for the six month period of July 9, 1990 to January 11, 1991. This time period is especially significant since it captures the Dow Jones Industrial Average peak at 2999.80; the economic shocks of the OPEC meetings, the invasion of Kuwait by Iraq, and the commitment of international forces to the Mid East; and the seeds of the economic recession that the U.S. was entering at the end of the study. This volatile economic environment will aid the analysis of efficient reaction of stock prices to information.

The 99 numeric values accumulated over the 131 market days included in the study which resulted in 12,969 different numbers were organized and entered into the VAX mainframe computer in 12 data files. The format of the data files would allow access and manipulation by SAS, a statistical application program located on the VAX mainframe.

**Explanation of Statistical Concepts**

Before explaining how the numbers apply to the theory of stock market efficiency, it is necessary to explain certain statistical concepts. This will help in the understanding of how and why statistical techniques were used and how the results of the study can be interpreted.

Dependent variable -- variable that is being explained about in the analysis.

Independent variable(s) -- variable(s) that have a potential relationship with the dependent variable and are used to explain the dependent variable's value (Hu 67).

Multi-variate Linear Regression -- This is a statistical technique that determines the nature and strength of a relationship between a dependent variable and two or more independent variables (Levin 508). Essentially, this technique manipulates the coefficients of the dependent variables in order to find the equation that comes the
closest to equaling the dependent variable. Computers are an invaluable resource in such an analysis because of their immense speed, accuracy and comprehensiveness in determining the relationship.

Coefficient of determination ($R^2$) — the fraction representing the variation in the dependent variable that is explained by the independent variables (Levin 580). Values range between 0 and 1 with 0 meaning no explanatory in the model and 1 meaning that the variation in the dependent variable is completely explained by the independent variables.

F-statistic -- value used to determine whether the relationship between the independent variables and dependent variables is significant or just coincidental (Levin 591).

T-statistic -- value used to determine whether an independent variable is a significant explanatory variable in the relationship (Levin 593).

**Statistical Tests**

In order to show a weakness in the theory of semi-strong market efficiency, it was necessary to compare relationships using stock prices as the dependent variable and economic and market indicators as independent variables. If the model is to contradict the theory of semi-strong market efficiency, one must be able to use publicly available information to predict stock returns. This would prove that the market in fact did not adjust to the publicly available information. In one set of regressions, the economic and market indicators would be related to the stock prices for the same day. In the second set, the economic and market indicators would be related to the stock prices for the next day, thereby creating a lagged effect. If the $R^2$ score for the lagged relationship is greater than the $R^2$ for the non-lagged relationship, then the stock price did not reflect all publicly available information for that day which weakens the theory of semi-strong market efficiency.
Since there could only be one dependent variable and there were prices for 36 stocks, and index had to be created. There was a choice between an equally weighted index and a value weighted index (Figure 3). The value weighted index method was chosen because it took into account the relative importance of each stock to the index. If the stock has a relatively high outstanding number of shares or price it is more likely that it is widely held and actively traded. Consequently, information will have more of an impact on these firms and this relationship should be included in the model through a value weighted index. Such an index was created for all of the 36 stocks and then smaller indexes for just the 20 stocks listed on the New York Stock Exchange, just the eight stocks listed on the American Stock Exchange, and just the 8 stocks traded Over the Counter on the NASDAQ system. These four indexes were used as dependent variables in the regressions.

The next step was to regress these indexes against the economic and market indicators to determine which variables were important predictors of stock price value and whether any lagged effect existed. Since the indicators were grouped in four data files, these groupings were used to separate them into initial variable groupings. Each of the four groups had common characteristics. The first group were all market value indicators. The second group were directional volume indicators or commodity values. The third group included debt and liquidity indicators. The last group consisted of total market volume statistics (Figure 4). A statistical tool in the SAS program took the independent variables and ran regressions for each combination. That is for n variables the computer would run \(2^n - 1\) regressions and then listed them in descending order according to their \(R^2\) value. This aided greatly by cutting down the number of different programs to be constructed and ran not to mention the fact that it allowed an easy comparison of a number of regressions on one page.

The results of the initial four regressions yielded certain problems. First of all, since the indicators in each of the four groups were of the same nature, the explanatory
power of each of the variables in one group was similar to that of the other. For example, in the first group, the variance that can be explained by the value of the Dow Jones Industrial Average is similar to the variance that can be explained by the Standard and Poor's 500 index. This duplicative effect showed a need for a mixture of variables with different characteristics and explanatory power. Second, the non-lagged data had higher $R^2$ values than the lagged data. This resulted from the fact that the indicators were not chosen specifically on the basis that they would have a potential lagged effect on stock price. Consequently, the model needed a more diverse and well selected group of independent variables.

The field of 27 indicators was narrowed down to a group of seven that were thought to have an important lagged impact on stock prices. These were:

- the Japanese Nikkei average -- similar to the Dow Jones Industrial Average in nature and reputation. This is an index of 225 stocks that trade on the Tokyo Stock Exchange.
- the Dow Jones Industrial Average -- a composite of 30 top industrial U.S. stocks.
- the Federal Funds rate -- the interest rate at which banks loan other banks short-term, often overnight money so that the borrowing institution can meet the reserve requirements of the Federal Reserve.
- the Dollar index -- an index of the price of the dollar in the major foreign currency markets.
- the Advance Decline value -- the cumulative amount of advancing minus declining issues on the New York stock exchange. An advancing issue is a stock that closed at a higher price than it did the previous trading day while declining issues decreased in price.
- the Longbond yield -- the interest rate on a 30 year U.S. treasury bond.
- the Standard and Poor's 500 index -- an index of the price of the 500 top rated stocks as selected by the Standard and Poor's rating service.
The combination of the seven indicators yielded much better results. For each of the price indexes, certain indicators resulted in a higher $R^2$ for the lagged relationship than for the non-lagged relationship (Figure 5). The indicators that caused a lagged relationship varied for each of the four price indexes. The next step is to explain why such a lag would exist in markets that are usually considered to be efficient. First, the market characteristics that would allow a lagged relationship to be stronger will be explained. Then, each one of the price indexes will be considered separately to explain why certain variables created a stronger lagged relationship.

**Structural Market Characteristics**

The strength of a stronger lagged relationship can be explained by the fact that the New York Stock Exchange, American Stock Exchange, and NASDAQ trading system for Over the Counter stocks are only open from 9:30 am to 4:00 pm EST. During the rest of the day and night the stock market is closed while the value of a company may vary. Company, industry, and economic information may arrive while the markets are closed which may affect the value of the company and create a lagged effect. Jacobs proposes that unanticipated news that comes in close to the close may not be fully reflected until the next morning. Miller supports the assumption that since "the market is closed much longer than it is open, one would expect significant information to appear when the market is closed" (11). He adds that public information may arrive at various times and that information on macroeconomic variables and on political developments are more likely to appear when markets are closed (13). Consequently, the fact that the world operates even when the market does not is a key factor to explaining why there is a stronger lagged relationship.

Certain characteristics relating to the structure of the market and the existence of trading rules reinforces the lagged response of stock prices to public information. A daily trend noticed in the markets is that there are market rallies when price goes up
during the first 45 minutes and the last 15 minutes of the trading day (Jacobs & Levy 35). This trend has also been shown to be pervasive over time and over various market value groups (Harris 64). There are many explanations to why these rallies take place. From a structural viewpoint, since the closing prices are reported in the press and stored in the databases, they may be manipulated upward to make the company look good — a technique called "window dressing" (Jacobs & Levy 36). Another structural characteristic is settlement rules. If one party promised to deliver a security by the close on a certain day, that party may wait until the very end of the day in an effort to get the best price. This will put a lot of demand on a security at the end of the day which may increase price (Admati 34). Another structural characteristic of the New York Stock Exchange and American Stock Exchange is the price-smoothing mechanisms present in these markets. Keeping order in these two markets involves making a gradual transition in price to reflect the arrival of new public information (Hasbrouck 190). These mechanisms may delay the full effect of information on a stock price and this lagged adjustment may occur over two days. It is for these reasons that trading pressure that exists at the close of the trading day may cause the closing stock price not to reflect its actual value based on information about the stock. The adjustment to the real value would take place the next day, thus causing a lagged adjustment to the public information that was present the day before.

To a certain extent, size has an effect on how public information is processed and how much of a lag is present in the adjustment of prices. For one thing, it is easier to observe larger firms which means that it is also easier to make buying decisions based on that information. Smaller firms that are more hidden from the public eye may not react to public information as quickly (French & Roll 8). Hasbrouck supports the theory that the lag in adjustment and the information asymmetry is more significant for firms with smaller market values (205). Because the selection process used to select stocks for the study selected firms with less than 20 million shares outstanding, the market values
tended to be low. The largest market value of the 36 firms was about $650 million dollars and many firms had market values of less than $100 million. Compared to a mean of $2233 million and a median of $577.7 million for the entire database of 1600 stocks, the firms selected can be described as relatively small. As a result, information about these companies is not acted on as quickly as firms with large market values. This, in turn contributes to the reasons for lagged adjustment to publicly available information.

**Explanation of the Independent Variables for the Four Indexes**

*The New York Stock Exchange Sample Index —*

Initially six of the seven indicator caused the lagged relationship to have a higher \( R^2 \) than the non-lagged relationship. These indicators were: the Japanese Nikkei average, the Dow Jones Industrial Average, the Federal Funds rate, the Dollar index, the Advance Decline value, and the Standard and Poor's 500 index. Even though these independent variables created a high \( R^2 \), it is possible that some of the variables were not significant and have little explanatory power. Looking at the statistics in Figure 6, one notices that the T-score for the Dow Jones Industrial Average is .113. If the T-score is less than 1.96, then the variable is statistically insignificant at the 5% level. Therefore, the Dow Jones Industrial Average is not a significant indicator. This makes sense for two reasons. First, the Dow Jones Industrial Average only uses thirty stocks which makes it not very representative of the diverse types of industries and companies that are on the New York Stock Exchange. As a result, the small New York Stock Exchange stocks that were present in the research, were not closely related to the large ones in the Dow Jones Industrial average, hence, the low level of significance. Second, the Standard and Poor's 500 index represents the same thing as the Dow Jones Industrial average -- a market price indicator. Using both of them created a duplicative effect which also contributed to the lower significance for the Dow Jones Industrial Average.
The Advance-Decline line, on the other hand, had a relatively large T-score of 13.033 (Figure 6). At first, one might say that a variable with such a T-score has superb explanatory ability. However, a high T-score may be a symptom of a problem in statistics called multicollinearity (Hu 87). This occurs when an independent variable is so interrelated with the dependent variable that the independent variable overpowers all of the others. In addition, the information gained from the relationship is expected and does not explain much. For example, if profits was the dependent variable and sales, number of employees, and number of hours open were the independent variables, sales would have a tremendously high T-score because it is so interrelated with profits. However, this does not tell a person much because it is expected that higher sales will lead to higher profits. This is the case with the Advance-Decline line and the value of the New York Stock Exchange stock's index that was created. The Advance-Decline line is an indicator of the price strength of the market since it shows the cumulative number of the difference of stock issues that have increased in price less the stock issues that have decreased in price. The index of 20 New York Stock Exchange stocks is also an aggregate of a number of stocks that increase and decrease in price. Therefore, it is not surprising that the Advance-Decline line has a high T-score because of its parallel nature to the price index. The Advance-Decline line is therefore a victim of multicollinearity and overshadows the importance of the other independent variables. It was dropped from the relationship.

The other four indicators that were left were used in a relationship with the New York Stock Exchange index of 20 stocks. A comparison of the lagged and non-lagged relationship statistics are in Figure 7. It shows that the non-lagged relationship has a $R^2$ of .9306 while the lagged relationship has a $R^2$ of .9363. In addition all of the independent variables were significant because they had T-scores larger than 1.96. The lagged relationship is stronger and each one of the contributing variables will be analyzed.
The first variable to be considered is the Tokyo Stock Exchange Nikkei Average. A growing trend in today's markets is the increasing globalization and interdependence among different countries. Financial markets which include stock markets are no exception to this trend. Laderman comments that the U.S. and Japanese stock markets are inextricably linked and that players in both markets start their day by noticing what the other has done. Investors do not restrict themselves to watching the Nikkei average or even just the Japanese markets. U.S. investors take note of the activity of stock markets all over the world (Laubscher 148). The Nikkei average was used for two reasons. One, the Japanese economy is regarded as one of the strongest and fastest growing in the world. Therefore, the Nikkei average was probably the best choice among international stock indicators. Using more than one would cause a duplicative effect in the relationship. The second reason that the Nikkei average was used is that there was relatively easy access to the information.

The contribution of the Nikkei average to the strength of the lagged relationship comes from the fact that the Japanese markets are open when the U.S. markets are not. Figure 8 shows this relationship between market operating times. The Japanese and other markets can therefore react to information released after the close of the U.S. markets. This information would more than likely be of an economic or industry nature. The value that is recorded for the Nikkei Average on one day contains public information that is not able to be reflected in the U.S. markets until the next day. Hamao supports the assumption that international financial integration exists and that world stock markets react similarly to the same information (306). This assumption that information arrives overnight and is used in foreign markets explains the high amount of trading observed in the first 45 minutes of trade noticed by Jacobs and Levy. They also propose that orders at the open are heavily influenced by foreign investors (36). This may mean that these investors are trying to take advantage of the information that already caused price movements in their markets. Since information does arrive while
U.S. markets are closed, the Nikkei average has reflected the effect of this nocturnal information and is therefore helpful in explaining the lagged effect that exists for the New York Stock Exchange 20 sample stocks.

The Federal Funds rate is the next independent variable that caused a stronger lagged effect. The characteristics of the federal funds rate partially explains why it helps the lagged relationship. The federal funds rate is the interest rate at which banks lend other banks money on a short term, usually overnight, basis. From one point of view, this may be a sign of economic strength. If firms are optimistic enough to borrow funds from banks for new projects, this may create a need for these banks to borrow from other banks. This may be a signal of economic growth and an increase in the firm's stock price. Consequently, a high demand for federal funds which means a high federal funds rate may be directly related to the index price. A second explanation of relationship may be a result of the Federal Funds rate helping to predict what Federal Reserve Policy will be. Almost always, Federal Reserve policy about how much money will be injected into the economy is kept secret. However, expectations of what the policy will be or uncertainty about Federal Reserve policy affect the Federal Funds rate (Tabellini 434). Consequently, the Federal Funds rate can be considered an indicator of national economic policy or uncertainty. If the rate is high this indicates projections of tight monetary policy when banks need to borrow to meet reserve requirements or it indicates uncertainty when banks want to borrow to be safe in the uncertain situation. The Federal Reserve uses the Federal Funds Rate as a policy instrument even though they do not directly control it. The Federal Reserve can influence the rate which serves as a signal to banks about the Fed's policy. If banks follow this signal, this could serve as a better monetary tool than other, more drastic measures the Fed could take. However, secrecy about policy which causes speculation makes the Federal Funds rate more variable and may make it harder for the Federal Reserve to control (Tabellini 434). Uncertainty about the economy and tight monetary policy also means that companies
will want to play it safe and that they won't be able to borrow as much which means that a higher federal funds rate is inversely related to the index's price. Though both explanations may be valid, the stronger explanation is the first one since the coefficient for Federal Funds rate in Figure 7 is positive. Since large east coast banks do not typically close until 5:00 pm EST, there is an hour in which new expectations, information, or uncertainty about monetary policy can change the Federal Funds rate. Therefore, the Federal funds rate contains information about the strength of the economy and the direction of monetary policy that is not reflected until the next day in the U.S. stock markets.

Another indicator is the dollar index. The dollar index, as mentioned before, is the index of the price at which the dollar trades against other major international currencies. Since the dollar index reflects the strength of the dollar with respect to other currencies, it is a valuable indicator of the strength of the U.S. economy and the characteristics of U.S. balance of trade. A rise in the price of the dollar would also cause a rise in the price of U.S. exports. In the short run, this is good for firm because contracts of sale between countries makes it take a while for trade flows to change. This is also called the J-curve effect (Melvin 144). Meanwhile, U.S. companies trading abroad are getting more foreign currency per unit sold than they did before because of an increase in the price of the dollar. The opposite for a decrease in the price of a dollar is also true. This means that at least in the short run the firms value will be directly related to the dollar index. This is reflected by the positive coefficient in the regression. Once again, currency trading occurs in many international markets while U.S. stock markets are closed. Therefore, international economic events which affect the value of the dollar and the potential growth and profitability of U.S. firms cannot be reflected until the next day when the markets open up. In addition Soenen and Hennigar state that stock prices may react with a lag to exchange rate fluctuations because of the time it takes for capital flows to reflect changes in the currency's strength (7).
The last independent variable which caused a higher $R^2$ for the lagged relationship is the Standard and Poor's 500 index. As explained before, this is more comprehensive as a market indicator than the Dow Jones Industrial Average. However, since this includes stocks from the same market the sample is from, this raises the question of multicollinearity again. There are a couple reasons why multicollinearity is not believed to exist in this relationship. First of all the T-score is not extremely high. Second, the stocks in the S&P 500 index are mainly large firms of high quality. The 20 firms in the New York Stock Exchange sample index are small firms with relatively low quality ratings. The S&P 500 index is believed to be a good indicator for the lagged relationship because it shows the general direction of the markets. If the large firm's stock price moves in one direction, investors in the smaller stocks may take this as a signal and react. The reaction may be a lagged reaction after these small investors analyze the closing numbers and decide their trading strategies for the next day. Even if investors act more quickly and would not necessarily wait until after close, the end of day rally which may push indexes such as the S&P 500 index up may not allow enough time for small firm investors to follow this signal. Consequently, the closing of the market makes the Standard and Poor's index a signal for the direction of the price movements of smaller firms on the next day.

The American Stock Exchange Sample Index --

The index of eight American Stock Exchange stocks in the sample has a stronger lagged relationship as a result of three indicators. These are the Dow Jones Industrial Average, the Standard and Poor's 500 Index, and the Dollar Index. As is shown in Figure 9, the lagged relationship has an $R^2$ of .9353 while the non-lagged relationship's $R^2$ is only .9349. The T-scores are all significant which indicates that these variables have explanatory power. Even though the lagged $R^2$ is higher, there is a small margin. This may be a result of the duplicative explanatory effort of the two price indicators --
the Dow Jones Industrial Average and the Standard and Poor's 500 Index. As shown in
Figure 5, there is a large difference between $R^2$s when each is in a regression separately.
The regression with both of them in is higher, even though by a small margin, and the reasons for this relationship will be considered.

As with the previous regressions dealing with the New York Stock Exchange
sample stocks, the American Stock Exchange sample stocks take signals from the price
movements of larger stocks. It is for this reason that the movement of the S&P 500
index affects the price of the stocks. This price index is an indicator of financial strength
in the economy and in the stock market. If there is a stock market rally where the S&P
500 value increases in price right before the close of the market, it is in these cases that
investors might have to wait until the next morning to make transactions based on this
new information gained from this index. The Dow Jones Industrial Average is another
indicator that was found to be a significant factor in the lagged relationship. This
average, however, was dropped from the list of indicators used in the New York Stock
Exchange sample index regression because of its insignificance. The reason that it is
significant for American Stock Exchange stocks may be that since the Dow Jones
Industrial Average stocks are traded on the New York Stock Exchange, news about the
price movements may be delayed more than other forms of information. The Dow
Jones Industrial Average has also been known to rally at the end of a trading day. As a
result, the greater lag that is faced on the American Stock Exchange may increase the
probability that information about changes in the Dow will not be reflected until the
next day.

The third indicator is the dollar index. This factor is significant for the same
reasons as explained in the New York Stock Exchange Sample regression. Even though
American Stock Exchange companies are typically smaller by comparison to New York
Stock Exchange stocks, the effects of increasing globalization of product and financial
markets are felt by smaller U.S. companies as well. The dollar index is an indicator of
the position of the U.S. economy in the international markets and this index has much informational value for traders. As mentioned before, since currency is traded while the U.S. equity markets are closed, international and domestic political and economic developments may be reflected in the change in the value of the index. Stock traders have to wait until the markets open to react on this information. Therefore, the dollar index supports the strength of the lagged relationship.

*The Over The Counter Sample Index* --

The index of eight Over The Counter stocks in the sample has a stronger lagged relationship as a result of two indicators. These are the Federal Funds Rate and the 30-year Treasury Bond. Figure 10 shows that the $R^2$ for the lagged relationship is .4461 while the non-lagged relationship has an $R^2$ of .4268. This leaves a lot of unexplained variation but the relationship is still significant since the F-score is large enough to pass the relationship significance test at the 5% level. The variation that is explained reveals how there is a lag in information transmission for variables important in the Over The Counter market. Both the Federal Funds Rate and the 30-Year Treasury Bond are significant independent variables from observing their T-scores.

First of all the Federal Funds Rate is significant in the lagged relationship for the same reasons as identified for the New York Stock Exchange sample regression. An increase in the rate may indicate that there is heavy borrowing in the economy which indicates a growing economy. An increase might also indicate that the money supply is being cut which creates a need for liquidity through the Federal Funds market. These two factors have specific implications for Over The Counter Stocks. These stocks typically have lower total market values or number of shares, which is a reason the company chooses not to list them on an organized exchange. This may mean that these companies rely on debt financing to a greater extent which makes them more vulnerable to changes in interest rates. In addition, since these firms are smaller, they
may be more domestically oriented which makes them more sensitive to changes in
domestic monetary policy which has been shown to be reflected in the Federal Funds
rate. For these reasons, the Federal Funds rate provides valuable information for Over
the Counter stock traders. As mentioned before, the federal funds rate are probably not
be determined until after the stock markets are closed which means that some
information in the level of the Federal Funds rate may have to wait until the next day to
be acted upon.

The other indicator, the 30-year T-bond also provides Over The Counter stock
traders with important information about U.S. economy. The 30-year T-bond, or the
LongBond as it is called, is helpful in predicting where rates are expected to go in the
future. Even though it is a 30 year bond, its predictions are valid for time periods far
less than 30 years. If the rate on this bond is higher than the rate on a 90 day treasury
bill, interest rates are expected to rise. If the rate is lower than shorter term rates then
rates are expected to fall. These expectations about bond interest rates have effects on
the stock market (Laderman 100). As mentioned before, the Over The Counter stock
companies are likely to rely more heavily on debt as a form of financing and are
therefore more sensitive to expectations about rates. The LongBond interest rate can
therefore be an important signal about the success of some companies. The arrival of
this information is also important in determining when it is processed. Treasury
auctions often occur when the markets are closed which means that the resulting
change in rates and information that comes as a result of this will have to wait until the
next trading day to be included in the market.

All 36 Stocks Sample Index --

The index of all 36 stocks in the sample reveals which indicators of the seven
chosen have a stronger lagged than non-lagged effect. The results show that the Dow
Jones Industrial Average and the Standard and Poor's 500 index have a stronger lagged
effect when considered separately but not when considered together. Once again the duplicative effect of having two market indicators in the regression lessens the effectiveness of each one in the lagged relationship. In Figure 11, the first regression shows that the non-lagged $R^2$ is .9296 while the lagged $R^2$ is only .9265. A comparison of the F-scores shows that the non-lagged relationship is much more significant. However, if each of the independent variables is considered on an independent basis, the lagged relationship shows its relative strength. The $R^2$ and F-scores are higher for the lagged relationship in the other two regressions. The T-scores in all of the regressions reveals that both the Dow Jones Industrial Average and the Standard & Poor’s 500 index are significant variables.

Since the 36 stocks are a conglomeration of the individual exchange listings, it is not surprising that the indicators that would cause a lagged effect would be market strength indicators. Since the stocks in the sample are relatively smaller than the stocks in the Dow Jones Industrial Average and the S&P 500 index, the information gained from the movement in these larger indexes takes a certain amount of time to trickle down and affect these smaller stocks that are not directly related to these indicators. For stocks as a whole, regardless of which exchanges their on, it seems that the industry and stock market trends that are reflected in the Dow Jones Industrial Average and the S&P 500 index are the important explanatory factors. As explained before, last minute rallies may not affect the smaller stocks in the sample until the next trading day. This explains the existence of the strength of the lagged relationship.

**Impact of Technological and Structural Trends**

A pervasive theme to explaining why there is a strong lagged relationship in the various U.S. stock markets is the fact that the markets are only open for a limited amount of time. This is basically to ensure liquidity in the market, which means that it is likely that there are enough buyers and sellers during the day to make trading
feasible, while at night, there may not be. However, growth in the securities market and technological innovation may break down this time limitation that creates inefficiency in the processing of information. Baer and Evanoff state that financial transaction activity has grown exponentially (13). Therefore, there is probably a market for after-hours or even 24-hour trading. The New York Stock Exchange is not against this idea. In fact, they have been making plans for limited after-hours trading with plans for round the clock trading by the year 2000 (Laderman 30). The proposed means of trading would also change with the trading floor being traded in for computer screens and communications networks. These plans of the New York Stock Exchange are partially a result of the fact that the volume traded on the exchange has been dropping which means less income for the exchange itself. They hope to increase income through allowing trading at night (Laderman 30).

A big concern of the traders of the exchanges is that it may replace them and eliminate the trading floor. This may be true, but it is not necessarily bad. For example, on October 27, 1986, most of the trading on the London Exchange was transferred to computer control in what was called the "Big Bang". Computerized trading along with other regulatory changes created a trading system similar to the NASDAQ system in that the London Stock Exchange was brought to the desks of every broker in the country which removed physical limitations on the size and the location of the market (Brandenberg 99). Upon implementation of the system, the only problems they faced were computer and communications failures because they under-estimated demand. This problem was easily corrected. The results of the change are positive and the assumption that there would be liquidity problems are groundless ("Terminal Problems" 39). Consequently, from the successful example set by the London Stock Exchange, it is shown that computerized trading can be initiated at a large stock exchange without giving up liquidity in the market.

Another example of computers and after-hours trading comes from the issues
raised by the developments at the Chicago Board of Trade and Chicago Mercantile Exchange. This situation caused a lot of disagreement among and within brokers. On one hand many saw the innovation as inevitable and a way that they could make profits if they used the technology correctly (Hansell 182). Others felt that the use of computers would cut the spread that they normally make and the profits they make in "scalping" the market when trading for their own account. They felt threatened that this might put them out of business. In addition, many were skeptical about whether or not there would be enough liquidity through the use of computers and in after-hours trading (Hansell 187). These issues were raised back in 1989 and since then, after-hours trading and the computer system have been instituted and seem to be successful. The facts and the trends at the time pointed towards higher volume and the increasing use of computers. These are the trends that exist now in the New York Stock Exchange.

To react to the fears of conservatives on the New York Stock Exchange, certain issues have to be addressed. First of all, in reaction to the issue that traders will be put out of a job, this is a minor concern. For many traders, the conversion will be one from working on the floor to working behind the screen. If there are excess people that do have to be laid off, this just means that trading costs will be lower and there will be a more efficient allocation of labor resources to provide brokerage functions. Another issue is that many traders rely on seeing who they are trading with to see whether or not they can get a better deal in the trade. A computer system, on the other hand, would keep identities confidential and not allow this type of practice (Hansell, 185). To be fair, the purpose of the exchange is to allow companies to raise funds and allow parties to invest their money. Traders may be able to make a profit through hunting for a good deal, but the two functions of the market should remain the priority concern of the market. The last issue is whether there will be enough exchange activity to support after-hours or 24-hour trading. The proposal of the New York Stock Exchange is to start out slowly with a few "single price auction" where buys and sells are matched up and
then gradually work up to continuous and round-the-clock trading (Laderman 32). In addition, computers trade faster and easier than the trading floor. This reduction in trading obstacles will also cause an increase in the level of trading and liquidity. Consequently, computerized trading and after-hours trading on the New York and American Stock Exchanges would not encounter many labor and liquidity problems and would help to more efficiently and effectively fulfill the role of stock exchanges — to match buyers and sellers of stock at a fair price.

**Conclusion**

The statistical model developed that used 36 stocks helps to bring out structural inefficiencies that exist in the market. The relative strength of relationships that were lagged one day as compared to the relationships that were not lagged show that because the markets close, they are not able to transfer certain types of information until the next morning. This information took the form of economic, political, international, market-related, and debt-related information. Experts and empirical reasoning have shown that a lot of publicly available information arrives near the end of the trading day or after the trading day. It is not the trader's fault that this information is not processed. The blame for this semi-strong market inefficiency is placed on the schedules of the exchanges themselves. If the stock markets were open after-hours or for 24-hours a day, there is no doubt that the profit motive of traders would cause stock prices to reflect all publicly available information that right now comes too late. If there is after-hours trading the large price fluctuations that were identified as taking place at the beginning and the end of the day which results in mispricing will be lessened or eliminated. The advent of 24-hour trading would result in more fair-pricing of the stock and fewer opportunities to skim profits because of daily price trends. Computers will also aid efficiency through making transactions faster and through providing more information about what the state of trading is. Consequently, technological
advancements, increases in trading volume, and proposed changes in structure are helping the stock market evolve into a more efficient marketplace for the buying and selling of equity securities.
Works Cited


Figure 1
Supply and Demand Interaction in the Stock Market

Price

Supply

Demand

Quantity

Effect of non-competitive ask prices and bids on the stock market

Price

Surplus Supply

Equilibrium Price

Excess Demand

Equilibrium Quantity

Quantity
Figure 2
Stocks Selected through ValueScreen and Economic Indicators Used

Stock Dropped From Study.

**New York Stock Exchange Stocks**
- Amcast Industries
- Arvin Industries
- ARX, Incorporated
- Bell Industries
- Culbro Corporation
- Dynamics Corporation
- Fieldcrest
- Hartmarx Corporation
- Inter-Regional Financial Group
- Jamesway Corporation
- Knogo Corporation
- Monarch Machinery and Tool
- Omnicare Incorporated
- Oxford Industries
- Sparton Corporation
- Sterling Bancorp
- Talley Industries
- Texas Industries
- Wynn's International

**American Stock Exchange Stocks**
- American Maize "A"
- Barry (R.G.)
- Fischer & Porter
- Luria (L.) & Son
- Mediq Incorporated
- Perini Corporation
- Smith (A.O.)
- Town & Country

**Over The Counter Stocks**
- American Bankers Insurance
- Culp Incorporated
- Gandalf Technology
- J.B.'s Restaurant
- Manufacturer's National
- Preston Corporation
- Raymond Corporation
- Volt Information Sciences

**Economic Indicator:**

- Dow Jones Industrial Average
- Dow Jones Utilities Average
- New York Stock Exchange Index
- American Stock Exchange Index
- NASDAQ Composite
- Standard and Poor's 500 Index
- Standard and Poor's 100 Index
- Value Line Industrials
- Tokyo Stock Exchange Nikkei Average
- New York Stock Exchange Up Volume
- New York Stock Exchange Down Volume
- Advance-Decline Line
- Oil Composite
- Dollar Index
- American Stock Exchange Oil & Gas Composite

- Commodity Research Bureau Index
- London Gold
- 30-Year Treasury Bond
- Federal Funds Rate
- 90-Day Commercial Paper
- Corporate CD-Rate
- Treasury Bond Index
- Moody's Corporate Bond Yields
- Dow Jones 20 Bond Index
- New York Stock Exchange Trading Volume
- American Stock Exchange Trading Volume
- NASDAQ Trading Volume
Figure 3
Comparison of Index Types

**Equal-Weighted Index:**
Initially a equal dollar value is invested in each stock at the inception of the index and then the total value of this portfolio is the value of the index.

e.g.: 10 shares of Stock A at $10
     20 shares of Stock B at $5
     
     Index Value = 200

In one month:
10 shares of Stock A at $12
20 shares of Stock B at $7

Index Value = 260 (30% rise)

**Value-Weighted Index** (Standard & Poor's 500 Index):
Prices of the stocks in the index are multiplied by their respective number of shares outstanding and then added up in order to arrive at a figure equal to the aggregate market value for that day.

e.g.: Stock A at $10 and 10,000 shares of Stock A outstanding
     Stock B at $5 and 100,000 shares of Stock B outstanding
     
     Index Value = 600,000

In one month:
Stock A at $12
Stock B at $7

Index Value = 820,000 (20% rise)

**Price Weighted Index** (Dow Jones Industrial Average):
Sums the prices of the stocks that are in the index and divides this by a constant divisor.

e.g. Stock A at $10
     Stock B at $5
     
     Divisor = 2
     Index value = 7.5

In one month:
Stock A at $12
Stock B at $7

Divisor = 2

Index value = 8.5 (13% increase)

Source: Alexander & Sharpe pp. 265-6
Figure 4
Groupings of Independent Variables in Initial Regressions

**Market Value Indicators:**
- Dow Jones Industrial Average
- Dow Jones Utilities Average
- New York Stock Exchange Index
- American Stock Exchange Index
- NASDAQ Composite
- Standard and Poor's 500 Index
- Standard and Poor's 100 Index
- Value Line Industrials
- Tokyo Stock Exchange Nikkei Average

**Directional Volume Indicators & Commodity Values:**
- New York Stock Exchange Up Volume
- New York Stock Exchange Down Volume
- Advance-Decline Line
- Commodity Research Bureau Index
- London Gold
- Oil Composite
- American Stock Exchange Oil & Gas Composite

**Debt and Liquidity Indicators:**
- 30-Year Treasury Bond
- Federal Funds Rate
- 90-Day Commercial Paper
- Corporate CD-Rate
- Treasury Bond Index
- Moody’s Corporate Bond Yields
- Dow Jones 20 Bond Index
- Dollar Index

**Total Market Volume Statistics:**
- New York Stock Exchange Trading Volume
- American Stock Exchange Trading Volume
- NASDAQ Trading Volume
Figure 5
Comparison of $R^2$ for the Different Sample Indexes

**New York Stock Exchange Sample Index**

<table>
<thead>
<tr>
<th>Independent Variables</th>
<th>Lagged</th>
<th>Non-Lagged</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nikkei, FedFunds, Dollar, S&amp;P 500</td>
<td>.93394</td>
<td>.93058</td>
</tr>
<tr>
<td>Nikkei, Dollar, S&amp;P 500</td>
<td>.93130</td>
<td>.92691</td>
</tr>
<tr>
<td>FedFunds, Dollar, S&amp;P 500</td>
<td>.92908</td>
<td>.92419</td>
</tr>
<tr>
<td>Dollar, S&amp;P 500</td>
<td>.92529</td>
<td>.91889</td>
</tr>
<tr>
<td>Nikkei, FedFunds, Dollar</td>
<td>.92136</td>
<td>.92140</td>
</tr>
<tr>
<td>Nikkei, Dollar</td>
<td>.92048</td>
<td>.91960</td>
</tr>
<tr>
<td>FedFunds, Dollar</td>
<td>.87472</td>
<td>.87538</td>
</tr>
<tr>
<td>Dollar</td>
<td>.87393</td>
<td>.87357</td>
</tr>
<tr>
<td>Nikkei, FedFunds, S&amp;P 500</td>
<td>.79828</td>
<td>.79273</td>
</tr>
<tr>
<td>Nikkei, S&amp;P 500</td>
<td>.78365</td>
<td>.77619</td>
</tr>
<tr>
<td>Nikkei, FedFunds</td>
<td>.76865</td>
<td>.76847</td>
</tr>
<tr>
<td>Nikkei</td>
<td>.76014</td>
<td>.75789</td>
</tr>
<tr>
<td>FedFunds, S&amp;P 500</td>
<td>.73582</td>
<td>.72419</td>
</tr>
<tr>
<td>S&amp;P 500</td>
<td>.70077</td>
<td>.68468</td>
</tr>
</tbody>
</table>

**American Stock Exchange Sample Index**

<table>
<thead>
<tr>
<th>Independent Variables</th>
<th>Lagged</th>
<th>Non-Lagged</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dow Jones Ind. Ave., Dollar, S&amp;P 500</td>
<td>.93527</td>
<td>.93486</td>
</tr>
<tr>
<td>Dow Jones Ind. Ave., Dollar</td>
<td>.90335</td>
<td>.89670</td>
</tr>
<tr>
<td>Dollar, S&amp;P 500</td>
<td>.89450</td>
<td>.88702</td>
</tr>
<tr>
<td>Dow Jones Ind. Ave., S&amp;P 500</td>
<td>.88035</td>
<td>.88310</td>
</tr>
<tr>
<td>Dollar</td>
<td>.87781</td>
<td>.87099</td>
</tr>
<tr>
<td>Dow Jones Ind. Ave.</td>
<td>.70443</td>
<td>.69939</td>
</tr>
<tr>
<td>S&amp;P 500</td>
<td>.59602</td>
<td>.58898</td>
</tr>
</tbody>
</table>

**Over The Counter Sample Index**

<table>
<thead>
<tr>
<th>Independent Variables</th>
<th>Lagged</th>
<th>Non-Lagged</th>
</tr>
</thead>
<tbody>
<tr>
<td>FedFunds, Long Bond</td>
<td>.44612</td>
<td>.42679</td>
</tr>
<tr>
<td>Long Bond</td>
<td>.41026</td>
<td>.39203</td>
</tr>
<tr>
<td>FedFunds</td>
<td>.01541</td>
<td>.01524</td>
</tr>
</tbody>
</table>

**All 36 Stocks Sample Index**

<table>
<thead>
<tr>
<th>Independent Variables</th>
<th>Lagged</th>
<th>Non-Lagged</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dow Jones Ind. Ave., S&amp;P 500</td>
<td>.92650</td>
<td>.92961</td>
</tr>
<tr>
<td>Dow Jones Ind. Ave.</td>
<td>.86945</td>
<td>.86419</td>
</tr>
<tr>
<td>S&amp;P 500</td>
<td>.79144</td>
<td>.78191</td>
</tr>
</tbody>
</table>
**Figure 6**
New York Stock Exchange Sample Index
with all Six Independent Variables

**Dependent Variable:**
New York Stock Exchange Sample Index

<table>
<thead>
<tr>
<th>Independent Variables</th>
<th>Lagged Coefficient/T-Score</th>
<th>Non-Lagged Coefficient/T-Score</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dow Jones Industrial Average</td>
<td>$.000181/.1113</td>
<td>$.000823/.507</td>
</tr>
<tr>
<td>Nikkei Average</td>
<td>$.000149/.943</td>
<td>$.000201/1.243</td>
</tr>
<tr>
<td>Federal Funds</td>
<td>-.048332/-2.462</td>
<td>-.043765/-2.171</td>
</tr>
<tr>
<td>Dollar Index</td>
<td>.091162/4.594</td>
<td>.090072/4.467</td>
</tr>
<tr>
<td>Advance-Decline Line</td>
<td>.002473/13.033</td>
<td>.002519/12.942</td>
</tr>
<tr>
<td>S&amp;P 500 Index</td>
<td>-.016263/-1.478</td>
<td>-.024026/-2.412</td>
</tr>
</tbody>
</table>

**Lagged**

R²: \( .9761 \)
F-Value: \( 836.226 \)

**Non-Lagged**

R²: \( .9752 \)
F-Value: \( 811.063 \)
Figure 7
New York Stock Exchange Sample Index
Final Regression

**Dependent Variable:**
New York Stock Exchange Sample Index

<table>
<thead>
<tr>
<th></th>
<th>Lagged</th>
<th>Non-Lagged</th>
</tr>
</thead>
<tbody>
<tr>
<td>$R^2$</td>
<td>.9339</td>
<td>.9306</td>
</tr>
<tr>
<td>F-Value</td>
<td>441.828</td>
<td>422.277</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Independent Variables</th>
<th>Coefficient/T-Score Lagged</th>
<th>Coefficient/T-Score Non-Lagged</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nikkei Average</td>
<td>.000680/3.031</td>
<td>.000789/3.406</td>
</tr>
<tr>
<td>Federal Funds</td>
<td>.066170/2.236</td>
<td>.078498/2.580</td>
</tr>
<tr>
<td>Dollar Index</td>
<td>.320083/16.022</td>
<td>.325810/15.818</td>
</tr>
<tr>
<td>S&amp;P 500 Index</td>
<td>.017508/4.878</td>
<td>.015136/4.081</td>
</tr>
</tbody>
</table>
Figure 8
World Time Chart and Trading Hours of Major World Exchanges

Figure 1
Exchange trading hours
Figure 9
American Stock Exchange Sample Index Regression

**Dependent Variable:**
American Stock Exchange Sample Index

<table>
<thead>
<tr>
<th></th>
<th>Lagged</th>
<th>Non-Lagged</th>
</tr>
</thead>
<tbody>
<tr>
<td>$R^2$</td>
<td>.9353</td>
<td>.9349</td>
</tr>
<tr>
<td>F-Value</td>
<td>606.864</td>
<td>607.610</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Independent Variables:</th>
<th>Coefficient/T-Score</th>
<th>Coefficient/T-Score</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dow Jones Ind. Ave.</td>
<td>.016162/8.908</td>
<td>.017540/9.658</td>
</tr>
<tr>
<td>Dollar Index</td>
<td>.244685/10.339</td>
<td>.239182/15.818</td>
</tr>
<tr>
<td>S&amp;P 500 Index</td>
<td>-.115069/-7.882</td>
<td>-.126282/-8.626</td>
</tr>
</tbody>
</table>
Dependent Variable:
Over The Counter Stocks Sample Index

<table>
<thead>
<tr>
<th></th>
<th>Lagged</th>
<th>Non-Lagged</th>
</tr>
</thead>
<tbody>
<tr>
<td>R²</td>
<td>.4461</td>
<td>.4268</td>
</tr>
<tr>
<td>F-Value</td>
<td>51.147</td>
<td>47.654</td>
</tr>
</tbody>
</table>

Independent Variables:  
Federal Funds Rate  
30-Year Treasury Bond

<table>
<thead>
<tr>
<th>Independent Variables</th>
<th>Coefficient/T-Score</th>
<th>Coefficient/T-Score</th>
</tr>
</thead>
<tbody>
<tr>
<td>Federal Funds Rate</td>
<td>.176907/2.868</td>
<td>.177172/2.786</td>
</tr>
<tr>
<td>30-Year Treasury Bond</td>
<td>-2.171362/-9.938</td>
<td>-2.161675/-9.587</td>
</tr>
</tbody>
</table>
Figure 11
All 36 Stocks Sample Index Regressions

**Dependent Variable:**
All 36 Stocks Sample Index

<table>
<thead>
<tr>
<th></th>
<th>Lagged</th>
<th>Non-Lagged</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Independent Variables:</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Dow Jones Ind. Ave.</td>
<td>R²: .9265</td>
<td>R²: .9296</td>
</tr>
<tr>
<td></td>
<td>F-Value: 800.142</td>
<td>F-Value: 844.750</td>
</tr>
<tr>
<td>S&amp;P 500 Index</td>
<td>R²: .7914</td>
<td>R²: .7819</td>
</tr>
<tr>
<td></td>
<td>F-Value: 485.729</td>
<td>F-Value: 462.519</td>
</tr>
<tr>
<td><strong>Coefficients/T-Score</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Coefficient/T-Score</td>
<td>Coefficient/T-Score</td>
</tr>
<tr>
<td>Dow Jones Ind. Ave.</td>
<td>.018266/15.272</td>
<td>.019313/16.382</td>
</tr>
<tr>
<td></td>
<td>-.106863/-9.924</td>
<td>-.115796/-10.901</td>
</tr>
<tr>
<td>S&amp;P 500 Index</td>
<td>.055956/22.039</td>
<td>.056480/21.506</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th></th>
<th>Lagged</th>
<th>Non-Lagged</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Independent Variables:</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>S&amp;P 500 Index</td>
<td>R²: .8695</td>
<td>R²: .8642</td>
</tr>
<tr>
<td></td>
<td>F-Value: 852.501</td>
<td>F-Value: 820.862</td>
</tr>
<tr>
<td><strong>Coefficients/T-Score</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Coefficient/T-Score</td>
<td>Coefficient/T-Score</td>
</tr>
<tr>
<td>Dow Jones Ind. Ave.</td>
<td>.006514/29.198</td>
<td>.006590/28.651</td>
</tr>
</tbody>
</table>