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The Effect of Changes in the Federal Funds Rate on Stock Markets: A Sector-Wise Analysis

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Abstract:

The federal funds rate is an indicator of monetary policy that investors in the stock market scrutinize very closely. This paper determines the relationship between changes in the federal funds rate and sector stock indexes. The paper goes on to determine why particular sectors are more sensitive to interest rate changes than others. Weekly returns of the Dow Jones ICB classified financial, energy, utilities, materials, industrials, consumer goods, consumer services, information technology, healthcare and telecommunications sectors are analyzed using separate OLS regression models for each sector. The results show that the utilities, financials, telecom and basic materials sectors are the most interest rate sensitive in that order and that the relationship exhibited between the stock price and the federal funds rate is positive. I conclude by attributing the positive relationship to sector specific demand and supply effects.

I. Introduction

December 23, 1913 saw the creation of an organization that changed the future of economics in the United States. The "Federal Reserve Act", created the Federal Reserve Bank, which has considerable clout in the functioning of the economy today via the implementation of monetary policy. The success of the Federal Reserve's (Fed's) monetary policy is usually measured by looking at economic variables such as output, inflation and unemployment. These aggregate variables, however, are at best indirectly affected by the Federal Reserve's actions.

Ben Bernanke, the chairman of the Federal Reserve said "The most direct and immediate effects of monetary policy actions, such as changes in the Federal funds rate, are on the financial markets" [Bernanke, 2005]. Stock markets are financial representatives of the strength of the United States economy. The New York Stock Exchange is the largest exchange in the world, with 2.674 billion securities and a market capitalization of $25 trillion [Yahoo! Finance]. The average dollar amount traded daily in the NASDAQ and Dow Jones is well into the billions. As stated by The Enquirer, "More people invest in the stock markets in the United States than own pets or have college degrees" [The Enquirer, 2002]. One must keep in mind that these people mentioned may not be individual investors, but also people who invest through their pension plans and through similar financial instruments like mutual funds. Nevertheless, they contribute to the stock market pool significantly.

The Federal Reserve's monetary policy is scrutinized every day by investors in stock markets. Changes in monetary policy could affect the stock markets either adversely or favorably, depending on the direction of the change. The change in

policy may be contractionary, increasing the federal funds rate, leading to a reduction in the money supply through a reduction in the non-borrowed reserves; or the change in policy may be expansionary, where a decrease in the federal funds rate increases the money supply through an increase in the non-borrowed reserves. These changes may be unanticipated or anticipated. Theories such as the present value of future cash flows (Presented by Crowder, 2006) about stock price valuation suggest that contractionary monetary policy will lower stock prices and vice versa. However, this posited negative relationship may be offset by changes in the money demand, since higher company earnings are associated with higher money demand and correspondingly, a higher interest rate, positing a positive relationship. Also, unanticipated policy changes affect the stock market more than anticipated ones due to the market's "forward looking" nature according to some theorists. The Fed Funds Futures rate helps determine whether policy was expected or unexpected and also allows us to see if the market is truly "forward looking" (when markets incorporate future changes in monetary policy into their stock valuation).

This study conducts a sector-wise analysis of the reaction of stock markets to anticipated and unanticipated monetary policy changes. The analysis is conducted by observing the reactions of the basic materials, consumer goods, consumer services, energy (oil and gas), healthcare, financials, industrials, technology, telecommunications and utilities sectors to changes in monetary policy. This paper argues that different economic sectors have different interest rate sensitivities, based on the effects of interest rate changes on revenues and costs. The results of this analysis and the conclusions derived from these results are reported in the final sections of this paper.

Section II presents similar literature on this topic. Section III presents the theoretical argument for this research. Section IV presents the data that I use to conduct the analysis; Section V displays the empirical model that I use to test my hypothesis; section VI presents my results and lastly, section VII presents the conclusions that I can draw from this analysis, policy implications and suggestions for future research.

II. Literature Review

This section presents the main conclusions of past literature that are most pertinent to my research. A discussion of how these findings were incorporated into this analysis is presented. There are a few problems and observations associated with the research question this project addresses. They are considered in this section of the paper, by observing what other authors did to correct for them.

The most significant article for this paper is by Bernanke and Kuttner [2005]. These economists perform an extensive analysis of the impact of monetary policy changes on equity prices. They claim, as stated above, that the most direct impact of monetary policy changes is on financial markets, which leads to the hypothesis for this paper. They are pioneers in using the Federal Funds Futures rate as an indicator for expected and unexpected policy changes, which is used for the same purpose in this research.

Bernanke and Kuttner use ordinary least squares regressions in their analysis, and find that an unexpected 25 basis point cut in the Federal Funds target rate is associated with a 1% increase in broad stock indexes. This result is set as a baseline estimate of how well the model presented in this paper accounts for the effects of monetary policy. They provide a sector-wise analysis as well, using portfolios developed

by a previous study by Fama and French [1988]. They conclude that the high tech and telecommunications sectors are the most responsive to changes in monetary policy due to their cyclical nature. However, the interest rate itself serves as an indicator to the economic business cycle and is a cyclical indicator. Bernanke and Kuttner [2005] claim that sectors exhibiting cyclical economic activity are the most sensitive to interest rate changes. This argument therefore, seems circular. No specific sector related reasons are provided by Bernanke and Kuttner [2005] to further their explanation of sector sensitivity to interest rate.

An earlier paper by Ehrmann and Fratzscher [2004], reaches the same results as Bernanke and Kuttner [2005]. They provide a comprehensive and sector-wise analysis of the effects of monetary policy changes on stock prices and find that industries characterized by relatively higher degree of cyclicality are the ones that react the most significantly to changes in monetary policy. Ehrmann and Fratzscher conclude that technology, communication and cyclical consumer goods industries are the most responsive to monetary policy changes. They observe average responses in the financial, industrial and basic material sectors. The least responsive industries are food, agriculture and beverages. This study and Bernake [2005] are the only literature that directly relate to the analysis in this paper.

Other studies have considered the effect of monetary policy on stock prices in general. Sellin(2001) surveyed the existing literature on the effect of federal funds rate changes on stock prices. The article provides competing theories about the way monetary policy changes influence stock prices. The theories posit both a positive and a negative relationship between monetary policy changes and stock prices, with arguments from real

activity theorists and Keynesian economists respectively. The Keynesian hypothesis is based on a sticky price model. Sticky prices imply that stock prices will not respond to a monetary shock in the short run, making the interest rate adjust to accommodate equilibrium in the money market. Keynes claims that a money supply change will affect asset prices (such as those of stocks) only if it alters the expectations about future Fed policy and/or causes a change in the future interest rates. For example, this theory posits that an announcement of a bigger money supply will lower stock prices because of an expectation of (i) a higher future interest rate, and (ii) lower future sales resulting from lower future economic activity. The Keynesians, therefore, expect a positive relationship between changes in the federal funds rate and stock prices, since they posit a negative relationship between money supply and stock prices.

The other competing theory is provided by the real activity theorists. They state that an announcement of a bigger money supply provides information about future money demand (accommodated by the Fed), which in turn is caused by higher future expected output. Higher expected future output would raise company future earnings, leading to higher expected future sales and therefore, higher stock prices[1]. The real activity theorists, therefore, expect a negative relationship between changes in the federal funds rate and stock prices, since they posit a positive relationship between changes in the money supply and stock prices. These competing theories make it difficult to predict a relationship between stock prices and interest rates *a priori*.

[1] This real activity theory coincides with Eugene Fama's "proxy hypothesis", which states that for a given growth rate in money supply, an increase in expected future output must lead to lower inflation for the quantity theory to clear. This implies that there is a positive relationship between monetary policy changes and stock prices and therefore a negative relationship between stock price and interest rate changes.

Deodola and Lippi [2005], Ganley and Salmon [1997] and Hayo and Uhlenbrock [2000] have also analyzed the effects of monetary policy changes on sector output. They develop indexes of financial and output measures that describe each industry's relative health and estimate a VAR model to incorporate monetary policy shocks into this index. While these economists use similar techniques, their analyses differ greatly. Deodola and Lippi [2005] analyze cross-sectoral effects of monetary policy in five OECD countries, including the United States; Hayo and Uhlenbrock [2000] estimate these effects in Germany only; and Ganley and Salmon [1997] present their analysis for the UK economy. Ganley and Salmon [1997] find that the 24 sectors they analyze in the UK are all equally responsive to an unexpected change in monetary policy, except for the construction and manufacturing sectors, which are more responsive. Hayo and Uhlenbrock [2000] find that about one half of German industries show significantly different reactions compared to the aggregate.

These three studies provide real output effects of monetary policy changes, which directly relate to stock price changes, since stock prices are an excellent indicator of the expected future profitability of a firm, economy or sector. An interesting fact to note here is that Deodola and Lippi [2005] find that monetary policy changes have the same effect on similar industries across countries. This observation means that the effects of a monetary policy change on a particular industry in the German economy will be similar for the same industry of any other OECD country, such as the United States. Therefore, the findings from all three papers can be used in this analysis.

It should also be noted that considerable heterogeneity in the effects of monetary policy changes across industries within countries was observed in the three

studies. This result is similar to Ehrmann and Fratzscher [2004] and Bernanke and Kuttner [2005] in that it posits that some sectors of the economy are more affected by monetary policy changes than others.

Although previous studies demonstrate this heterogeneity in the interest rate sensitivities of stock prices of different economic sectors, they have not considered the question of whether the relationship between changes in stock prices and interest rates is positive or negative. Most of the authors surveyed in this literature review posit a negative relationship (Crowder [2006], Bernanke [2005], Bomfin [2003], Peersman [2005]), however some authors posit a positive relationship (Sellin [2001], Thorbecke [1997], Patelis [1997], Maskay [2006], Park [2007]). There is some dissent on this relationship among the authors. The relationship is therefore difficult to determine *a priori*. Possible explanations for this dissension are provided in the theoretical model section of this paper and are alluded to by Sellin(2001) in terms of the Keynesian and real activity hypotheses explained earlier in this section.

Another issue in this research problem is the causality between monetary policy and stock prices. The rationale for monetary policy responding to stock prices would be that changes in stock prices predict changes in output. The reverse is also possible if stock prices respond to expected changes in output, which cause changes in monetary policy. Flood [2006] finds that stock prices do not predict changes in output growth regardless of the monetary regime in effect. Since the Fed's policies are based on the ultimate goal of changing output, the fact that stock prices and output growth are not correlated implies that the Federal Reserve does not react to stock market movements. He uses a Granger causality test, proving that stock market movements do not Granger-cause

changes in monetary policy, and that it is indeed the opposite (changes in monetary policy Granger-cause movements in the stock markets) that is true. This causality is therefore assumed to be true for this analysis.

A further issue with this analysis is the distinction between expected and unexpected monetary policy changes. Bernanke and Kuttner [2005] use the Federal Funds futures rate for this distinction. Since 25 basis points is the usual incremental change, they set a range of 25 basis points and argue that if the effective federal funds rate is within that range, the change would be considered an expected change. If not, the change would be classified as unexpected. I plan to use this classification technique in my paper.

Other studies worth mentioning are Bomfin [2003] and Patra [2006], who confirmed that this analysis should control for Federal Reserve policy variables. Bomfin [2003] confirmed that inflation needed to be controlled for, while Patra [2006] suggested the addition of GDP as a control variable. This study adds to the existing literature by providing a theoretical rationale for sector-wise interest rate sensitivities of stock prices. This study also breaks down Bernanke and Kuttner [2005] and Ehrmann and Fratzscher's [2004] arguments about cyclical sector sensitivity to interest rates into specific sector supply and demand characteristics and evaluates their sensitivities.

III. Theoretical Model

The most widely used theory for stock price valuation in modern financial literature is that of the present value of future cash flows. This theory is best elaborated by Crowder [2006], in his article "The interaction of monetary policy and stock returns".

Crowder provides us with the following equation for stock valuation:

$$P_{t+1} = E_t[\sum_{j=1}^{K}(1/1+R_t)^{j} D_{t+j}] + E_t\left[(1/1+R)^K P_{t+K}\right]$$

Where: P_{t+1} = Stock price; D_{t+j}= future expected cash flows;

E_t = expectations operator based on information;

R_t = Discount rate; and

K = investor's time horizon or holding period.

Monetary policy changes affect stock prices in two significant ways. First, policy can alter expected future cash flows (D_{t+j}) of the stockholders, therefore altering the return and pricing of the firm's stock. A monetary easing, i.e., a decrease in the federal funds rate, will increase the level of activity in the economy as a whole, which in turn raises firm's profits, increasing dividends and causing stock prices to rise. Monetary tightening will have the opposite effect.

The second way in which monetary policy affects stock prices is through the discount rate used by the market participants. This is a more direct way of influencing the prices, as discount rates used by equity market participants are generally tied to market interest rates. A tighter monetary policy will increase the federal funds rate, which increases the discount rate and causes stock prices to decline.

Crowder's model does not explicitly consider the equity premium, which is defined as the excess return that an individual stock or the overall stock market provides over a risk-free rate. This excess return compensates investors for taking on the relatively higher risk of the equity market. The size of the premium will vary as the risk of a particular stock, or for the stock market as a whole, changes i.e., high-risk investments are compensated with a higher premium. This problem, however, is resolved

by Bernanke [2005] who states that the equity risk premium or equity premium will be incorporated in the discount rate, because stock investors consider not only opportunity cost but also characteristics of an individual stock.

The other issue is the theoretical rationale for sectors having different sensitivities to interest rate changes. Though many authors in the literature review have observed this effect, no one has provided a theoretical rationale behind it other than noting that sectors with greater cyclical variation are more sensitive to interest rate changes. A possible theory behind this differential has to do with simple differences in sector supply and demand conditions and the monetary policy transmission mechanism. One must note that changes in the federal funds rate affect stock prices because a change in the Federal funds rate affects company earnings and future profits, which are inherently related to the company stock price.

Below are two graphical representations of the federal funds market. There are two ways that the federal funds rate can change. One is through a change in the non-borrowed reserves provided by the Federal Reserve Bank. An increase (decrease) in the non-borrowed reserves causes the interest rate to fall (rise), as illustrated in figure 1. The non-borrowed reserve amount is directly controlled by the Federal Reserve through open market operations. The other factor that affects the federal funds rate is the demand for these reserves. A rise (fall) in the demand for reserves increases (decrease) the interest rate as illustrated in figure 2. The demand for these reserves is broadly determined by economic activity. A booming economy would raise the demand for loans, which would increase demand for additional reserves, raising the federal funds rate and vice versa.

Federal Funds Markets

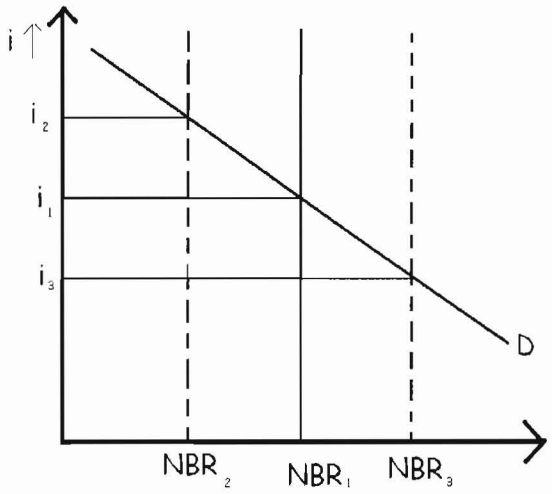


Figure 1

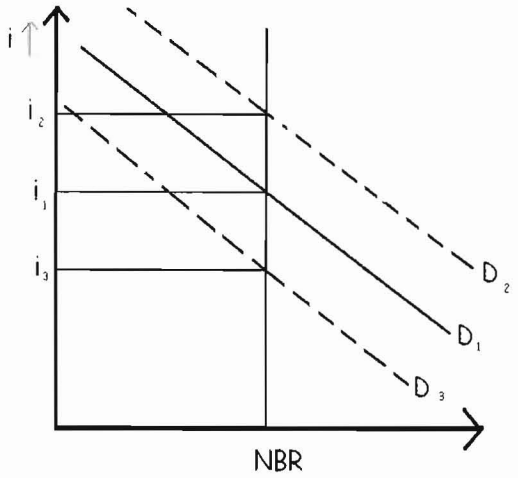


Figure 2

Thus, both supply and demand factors determine the federal funds rate. The demand effect posits that a booming economy would signal higher profits, which would raise corporate earnings and money demand, in turn raising both stock prices (due to the higher earnings) and the interest rate (due to increased demand). The result is a positive relationship between stock prices and changes in the federal funds rate. The supply side effect posits that there is a negative relationship between federal funds rate changes and stock prices. This relationship is present because an increase in the interest rate signals contractionary policy which precedes a slowdown in economic growth. In either the demand or supply cases, the costs of borrowing rise. However, in an expansion revenues are expected to rise, whereas in a contraction, revenues are expected to slow. So the net effect of the expansion in revenues and the increase in the cost of borrowing or change in profits resulting from interest rate changes lead us to conclude that it is difficult to determine the relationship between changes in the federal funds rate and stock prices *a priori*.

The sensitivity of sector profits to interest rate changes could be indicated by factors such as the sector's debt-heaviness, the average firm size and the age of the firms in the sector. A debt heavy sector would be more sensitive to interest rate fluctuations because when interest rates rise, the firm's debt burden rises and vice versa. So here the cost increase could be greater than the increase in revenues, leading to the hypothesis that debt heavy firms will be more interest rate sensitive. The average firm sizes in a sector and the average age of firms in a sector also have a role to play in interest rate sensitivity. Larger firms will have more borrowing alternatives than smaller firms and could therefore seek out cheaper rates in the case of a monetary tightening. Smaller firms, however, will not have access to these alternatives, making them more vulnerable to interest rate changes. Since the larger and more mature firms have access to these borrowing alternatives, they will not experience as high an adjustment in their effective interest rates when the interest rate changes in both directions. This means that a larger and more mature firm will have a more stable interest rate that is less sensitive to fluctuations in the interest rate of the broader economy. Smaller and newer firms, however, will experience significant sensitivity since they will not have a proven track record and will have a high risk premium. The presence of this risk premium will cause more fluctuations in the smaller and newer firms' effective interest rates, making them more sensitive to changes in the interest rates of the broader economy. Larger firms will also have economies of scale since they would borrow larger amounts, leading to a cheaper cost per dollar borrowed. Therefore, the smaller and newer the average firm size in a sector, the more sensitive the sector is to interest rate fluctuations.

As for the cost effect for the consumers, a higher interest rate will mean a higher net price paid for products financed by borrowing, which reduces purchases, thereby reducing sales and profits. By this reasoning, the consumer durable goods sector, for example, should display significant sensitivity to interest rate changes.

The table presented below show the debt-equity ratios of the various sectors used in this study.

Sectors	Debt to Equity
Basic Materials	0.436
Energy	1.371
Consumer Goods	2.483
Financial	3.252
Industrials	0.905
Consumer Services	1.566
Technology	0.766
Utilities	1.563
Telecom	1.597
Source: Yahoo! Finance	

As can be seen from the table, the most debt heavy sectors are the financial, consumer goods, telecom, utilities and consumer services sectors. Therefore I argue that these sectors will be more sensitive to changes in the interest rate. The data for the average age and the average firm size of each sector are not available due to the broad classifications of the sectors. Therefore, the arguments posited for these factors affecting the interest rate sensitivity of each sector cannot be tested empirically.

The demand effects of interest rate changes can be summarized as follows. In the consumer goods sector, there will definitely be some sensitivity due to consumer's higher cost of loans. The substitution effect, however, may not show in the data due to the broad definition of the sectors. There are two effects that counter each other here in that the necessity goods industries (such as cereal) will benefit and the luxury goods (such as cars) industries will lose sales. So the cumulative effect depends on which effect is

greater. These effects will hurt or improve the earnings of this sector, which is positively related to the stock price. These effects, however, may not be captured because of the broad definition of the consumer goods sector. The stock index for this sector is not divided into consumer luxuries and necessities, which is why these effects may not be observed in the results.

There are two opposing effects present in the financials sector as well. Higher interest rates increase financial institutions' earnings by an increased interest rate revenue from loans. The higher interest also increases the costs for a financial institution by increasing savings rate and concurrently the amount of interest paid to savers at the institution. Therefore, changes in interest rates affect both sides of the bank's balance sheet. The cumulative effect is difficult to estimate *a priori* since it depends on which effect dominates.

As in the financials and consumer goods sectors, there are two opposing cost and income effects on profits in all the sectors of the economy, leading to difficulty in estimating a relationship between monetary policy changes and stock prices *a priori*. A similar conclusion is presented by Sellin (2001) by way of the Keynesian and real activity hypotheses that are explained in the Literature Review section of this paper. However, the argument provided by Sellin (2001) looks at market expectations and not revenues and costs, but both Sellin's (2001) and the revenue and cost argument reach the same conclusion, that the relationship between monetary policy changes and stock prices is difficult to predict *a priori*.

There are many different aspects that enter into the theory determining the relationship between changes in monetary policy and stock prices. The demand and

supply effects interplay to produce a difficult *a priori* estimation of the relationship between the two variables. This difficulty of estimation has led to conflicting theories about the relationship from different economic theorists. The next section analyzes data and conducts an empirical analysis.

IV. Data

The variables being used for this analysis include sector stock indices, the effective Federal Funds rate, CPI (as a measure for inflation), the returns of the S&P500 index and the industrial production index. I use the weekly percentage change of these variables. Daily data are available and could have been used, but due to large amounts of investor noise, experts do not recommend its usage. Therefore, this paper employs weekly data.

The industrial production index and CPI-U are available on a monthly basis only, so weekly percentage change values are estimated by using the monthly value through each week of the month. This process is commonly called a moving average of the variables.

The weekly sector stock price data are obtained from the Dow Jones website, which breaks down the stock market into sectors and super-sectors, while providing stock prices for each sector by the creation of sectoral indexes. The indexes used include basic materials, consumer goods, consumer services, energy (oil and gas), healthcare, financials, industrials, technology, telecommunications and utilities.

The Federal Funds Futures weekly data are obtained from the Price-Data website, in the form of a CD-ROM. It is used to distinguish between expected and unexpected changes in the federal funds rate, mirroring Bernanke and Kuttner [2005].

The weekly effective Federal Funds rate data are obtained from the Federal Reserve website.

Literature reviewed for this project [Deodola and Lippi, Gulley and Bomfin] uses other measures of monetary policy, including Non-Borrowed reserves and monetary aggregates (M1,M2). This analysis uses the Federal Funds Rate because, by using its interaction with Fed Funds Futures data, it is easy to distinguish between anticipated and unanticipated policy changes.

The rest of the data variables are all used as controls in the analysis. Inflation is the first such variable, which is measured by the changes in the Consumer Price Index. The data for this variable are obtained from the U.S Bureau of Labor Statistics. Two kinds of CPI statistics exist: CPI for urban wage earners and clerical workers (CPI-W), and the chained CPI for all urban consumers (CPI-U). Of the two types of CPI, the CPI-U is a better representation of the general public, because it accounts for about 87% of the population. Therefore, the CPI-U is used for this analysis.

The other control variables that are used in this analysis include the Industrial production index and the weekly returns of the S&P 500 index. These data are obtained from the Federal Reserve board website and from the Yahoo! Finance website respectively. The industrial production index serves as a leading indicator for GDP and thereby acts as a control variable by distinguishing between money supply changes initiated by the Fed versus money demand changes caused by firms' increased money demand in a booming economy. A large, positive industrial production index change would indicate a booming economy, which would be associated with an increase in the money demand.

The S&P 500 returns are included because it serves two purposes, the first of which is that it controls for market risk. The second and more important fact is that the variable controls for the fact that firms use a mix of both equity and debt in their financing activities, whose proportions change with relative costs of each changing. The graphical charts for all these data variables are presented in Appendix A of this paper.

Observations are from January 1, 2002, to October 22, 2007. There are two reasons why there are no data presented before 2002. The first is that the Federal Reserve Bank changed its disclosure policy on interest rate changes in 1994, from a non-disclosure policy to a full disclosure policy. Therefore, data dating before 1994 would have caused problems in the analysis due to inconsistency with the Fed's disclosure policy. The second and possibly most influential reason the data do not date before 2002 is because of the events that occurred on September 11, 2001, which led to an upheaval in the stock market. Including these data would cause a great amount of variance in my dataset and could bias the results obtained due to the presence of conditional heteroscedasticity in the dependant variables (the sector-wise stock indexes).

In order to correct for autocorrelation problems in my data, I use weekly percentage changes in all the data variables. White's test for heteroscedasticity rejected the null hypothesis of homoscedasticity in my data. White's heteroscedasticity consistent covariance and standard error corrections are applied to the data to correct for this condition. The regression analysis is then run, details of which are provided in the following sections.

V. Empirical Model

Sector OLS regressions are used to test this paper's hypothesis.. The regression equation for each sector resembles the one presented below:

$$sector_i = \alpha + \beta_{1,i} FFR + \beta_{2,i} CPIU + \beta_{3,i} WRINDP + \beta_{4,i} SP500 + \beta_{6,i} E + \varepsilon$$

The model above could be classified as an augmented and modified two index Capital Asset Pricing Model (CAPM), as is seen in Stone (1974). The model includes the market return (SP500) as one index and the sector ($sector_i$) stock index as the other. The model developed by Stone takes interest rate sensitivities of equity securities into account (which is what we are trying to estimate in this paper) by including a second index, making it an apt model to mirror in this study. Stone does this by viewing an investment as a game where the "player chooses between two favorable bets—a sure thing yielding R_f (risk free rate) or a chance on the market return R_m." β_1 is the coefficient that requires the most focus in the results of this analysis, since it corresponds to changes in the federal funds rate, and therefore, the sensitivity of the sector stock index to changes in it.

The ($sector_i$) variable represents the sector's stock index. The financial, energy, utilities, basic materials, industrials, consumer services, consumer goods, health care, technology and telecommunications sectors are analyzed in this study, summing up to a total of ten regression analyses, one for each sector.

The different variables included in the above equation are explained as follows and their hypothesized sign is also presented.

- FFR (-/+): This is the weekly effective Federal Funds rate. The predicted sign of response to this variable may be positive or negative, because, as

discussed in earlier sections, the relationship between stock prices and the federal funds rate is difficult to estimate *a priori*.

- SP500 (+): This is the weekly return on the S&P 500. It is included in the model to avoid misspecification of the two index CAPM model. The hypothesized sign is positive because we expect the returns of the sector to coincide with the returns of a broader stock index, with a positive relationship. If the variable is not significant, then the model may be misspecified. It should be noted here that the beta coefficient ($ß_4$) associated with the SP500 variable represents the sector's beta (or a measure of the sector risk).
- CPIU (+/-): An index of prices used to measure the change in the cost of basic goods and services in comparison with a fixed base period. This is the urban consumer related index, which represents the CPI for 87% of the population. This variable accounts for nominal changes in the stock price and controls for the Federal Reserve's policy changes in response to changes in inflation. The data are available monthly and a moving average technique is applied to transform the data into weekly values.
- WRINDP (+): This is the industrial production index in the US economy, and it serves as a control for money demand and as a proxy for policy change due to output change. A growing economy usually is complemented by more industrial production and higher money demand due to higher expected future profits. Since expected profitability is also reflected by stock prices, they should be positively related to the industrial

production index. The data are available monthly, and the monthly data is estimated into weekly values.

- E (+/0): This is the dummy variable for the expectations of changes in the federal funds rate. It takes the value of 1 if the policy change is expected (is within the range of 25 basis points) and 0 if the policy change is unexpected (is outside the range of 25 basis points). The expected sign is theoretically positive, but may also be so small that it would be 0. This is because the change could be already incorporated into the stock price, indicating a truly forward looking market.

The next section includes the results of the 10 regressions that are run.

VI. Results

The results for the 10 regressions are presented in the following table:

Results Table

Sector	FFR	SP500	CPI	WRINDP	E	Durbin Watson	R-square
Basic Materials	0.0631 (1.9366)**	0.3917 (3.7578)***	-0.0577 (-0.1593)	-1.31E-05 (-1.6885)*	0.0001 (0.0268)	2.3898	0.0775
Consumer Goods	0.0312 (0.9230)	0.3206 (4.6051)***	-0.2000 (-0.9584)	-9.63E-08 (-0.0192)	0.0005 (0.2232)	2.5663	0.1311
Consumer Services	0.0255 (0.6548)	0.4533 (4.4056)***	-0.3185 (-1.2427)	1.67E-06 (0.4023)	0.0002 (0.0535)	2.6157	0.1163
Energy	0.0538 (1.5142)	0.2215 (2.0350)**	0.6773 (1.5233)	1.25E-06 (0.2898)	0.0013 (0.3479)	2.3721	0.0321
Financials	0.0745 (2.0725)**	0.4331 (4.1824)***	-0.3773 (-1.4375)	5.20E-06 (1.0142)	3.59E-05 (0.0118)	2.9128	0.1259
Healthcare	0.0221 (0.9071)	0.3238 (4.9106)***	-0.3136 (-1.2320)	4.75E-06 (0.9969)	0.0021 (0.6883)	2.66	0.0887
Industrials	0.0469 (1.1529)	0.4189 (4.1459)***	-0.2894 (-1.0562)	4.62E-06 (0.9625)	0.0004 (0.1229)	2.716	0.1147
Techology	0.0286 (0.4549)	0.5865 (3.2894)**	-0.3279 (-0.8336)	1.11E-05 (1.1546)	5.42E-05 (0.0122)	2.5756	0.094
Telecom	0.0834 (2.0129)**	0.5499 (4.7451)***	-0.4320 (-1.2666)	1.09E-05 (1.1889)	-0.0014 (-0.3994)	2.4326	0.1308
Utilities	0.1078 (2.1644)**	0.2813 (3.0379)**	0.0056 (0.0178)	-3.32E-06 (-0.8992)	0.0011 (0.2942)	2.4724	0.0669

Open values are beta coefficients. Values in parentheses are t-statistics
* = significant to 10%, ** = significant to 5%, *** = significant to 1%

The results presented above show that the augmented CAPM model is not misspecified. The S&P 500 returns are consistently significant throughout the ten regressions that were run. Therefore, we can assume that the model presents results that warrant interpretation.

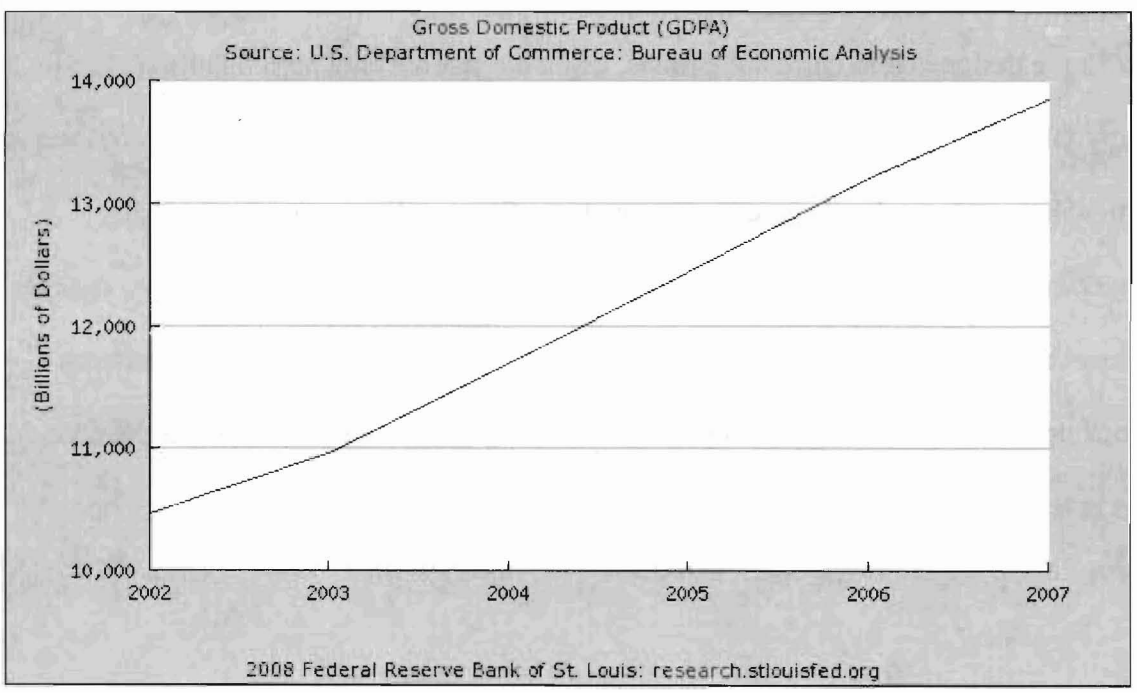
The Durbin Watson statistics for each regression show that there is no autocorrelation present in the results. Autocorrelation was present initially, and it was corrected for by using the percentage changes in the values of the independent variables. The heteroscedasticity problem was corrected for by using White's heteroscedasticity consistent covariances and standard errors, as mentioned earlier.

An inconsistency however, is that the industrial production index has a negative relationship with some sector stock indexes and a positive relationship with others. However, the results of the industrial production index were insignificant and no real conclusions can be drawn from them. A possible explanation for this negative and positive relationship is sector specific attitudes towards changes in the industrial production index, or the fact that this variable is not the best proxy, especially when a moving average technique has been used to create step-wise values.

The sectors that were the most interest rate sensitive were utilities, financials, telecommunications and basic materials, in that order. It must be noted here that distinctions between sectors paying high dividends versus sectors paying low or no dividends have not been made due to the unavailability of data. The sector's respective significance is measured by the t-statistics corresponding to the $ß_1$ coefficient. All of these sectors' stock prices exhibited a positive relationship to changes in the federal funds rate, supporting the Keynesian hypothesis presented by Sellin [2001]. The industrial

production index was supposed to control for money demand effects, which is the reason Keynesian economists attribute a possible positive relationship to changes in the federal funds rate and stock prices. This failure is attributed to the fact that the variable does not control for future expected changes, but for real time changes. The Keynesian hypothesis, however, relies on expected changes in Fed policy, which the industrial production index cannot control for. Finding another control variable that controls for future expectations of Fed policy and provides information on money demand is an arena for future research. Lagging the industrial production index may help in this regard. Therefore, the positive relationship between stock price and interest rate changes can be attributed to the revenue effect dominating over the cost effect and the Keynesian hypothesis, since our control variable does not completely control for these changes.

This relationship of higher interest rates being associated with higher profitability of companies and a higher stock price is also attributed to the specific time period used for the data. Between 2002 and 2007, the United States economy was recovering from an economic downturn and was booming. This is illustrated by the GDP graph presented below.



The GDP is growing exponentially in this time period. GDP also corresponds to expected future profitability and economic health, serving as an indicator to the revenue effect posited by my paper. Therefore, the revenue effect of increased future profitability outweighs the cost effect of increased interest rates in 2002-2007.

This observation of the time period determining part of the results hints at a time varying sensitivity to interest rate changes. This means that interest rate sensitivities have been observed to vary over different time periods. This effect is also observed by Park (2007) who observes that there could be positive, negative or even no sensitivity to interest rate changes for companies depending on the time period analyzed.

The reasons for the utilities sector being more interest rate sensitive than the rest can be observed once a typical utility company's balance sheet is observed. One large United States based utility company is the Duke Energy corporation, which provides electrical energy in central and western North Carolina, western South Carolina, southwestern Ohio, central and southern Indiana, and northern Kentucky; and transports and sells natural gas in southwestern Ohio and northern Kentucky. The balance sheet indicates total liabilities (as of December 31st, 2007) of $28.5b Out of these liabilities, $5.7b are designated as current liabilities, while the rest are long term liabilities. Long term liabilities are known to be more sensitive to interest rate changes, which provide a rationale for the results observed in this analysis. Since utility companies typically engage in large amount of long term debt, they are more sensitive to interest rate changes. However, sensitivity based on debt is associated with a negative relationship between stock prices and interest rates. Since the relationship observed in the results is positive, the revenue effect must dominate the debt/cost effect.

The telecommunications sector is also highly sensitive to interest rate changes. The reason for this sector's sensitivity is similar to the reason for the utilities sector being significant, given the debt/equity ratios presented in the table from Yahoo! Finance in the earlier section of the paper. It must be noted here, that the data being used for the dependant variable in the analysis is from the Dow Jones Website, so there may be some inconsistency with result interpretation based on Yahoo! Finance tables. When we look at a typical telecommunication company's balance sheet, it is seen that they too hold a large amount of long term debt. A typical telecommunications company is AT & T Inc [NYSE: T]. When we look at its balance sheet, we see that it has $39.3m in current (short term) liabilities, whereas, it holds $82.9m in long term liabilities and deferred long term liability charges alone. This high proportion of long term debt makes the sector highly sensitive to interest rate changes. However, here as well, the relationship observed between stock prices and interest rates is positive, leading to the conclusion that the revenue effect dominates over the debt/cost effect.

Financial sector companies, however, have large amounts of short term debt and less long term debt, so the same reasoning as the telecommunications and utilities sectors cannot be applied. The reason for the financial sector's sensitivity is related to the opposing cost and income effects discussed earlier. The cost effect posited a negative relationship, whereas the income effect posited a positive relationship to changes in the federal funds rate. Since we observe a positive relationship, we can conclude that the increasing interest income is greater than the increased cost of a higher interest rate for this sector. The higher interest rate, therefore, betters the positions of financial companies due to higher expected revenues, which increases stock prices. The reason for the

financials sector being sensitive to interest rate changes can therefore be attributed to the direct connection between interest rate changes and financial company revenues and costs.

The basic materials sector's stock prices also exhibit significant sensitivity to changes in the federal funds rate. When looking at the typical basic materials company's balance sheet, no extensive investment in long term debt is seen. Therefore, the debt cannot help us explain the interest rate sensitivity observed. However, the basic materials sector is sensitive to changes in the business cycle. Since the sector supplies materials for construction, it depends on a strong economy. This sector is also sensitive to supply and demand fluctuations because the price of raw materials, such as steel or other metals, is largely demand driven. Therefore, two reasons are attributed to this sector's sensitivity, one being its cyclical nature and the other is because its expected future profitability is largely demand driven. The cyclical nature of an industry making it more sensitive to interest rates is a similar finding to Bernanke and Kuttner [2005] and Ehrmann and Fratzscher [2004]. Changes in the federal funds rate act as indicators of the economy's health. Therefore, cyclical sectors respond strongly to changes in it and the basic materials sector is strongly cyclical. The second reason for this sector's sensitivity to interest rate changes is attributed to the fact that the future profitability for the industry is largely demand derived. Since a higher interest rate posits a healthy economy with more expected future profitability for other companies, the demand for basic materials will increase, increasing expected future earnings for basic materials companies, which will increase the stock price.

The consumer durable goods sector was expected to be significant before the analysis was conducted. However, as can be seen by the results, this was not the case. This disagreement may be because of the broad definition of the consumer goods sector, as alluded to previously in the paper. Dividing the consumer goods sector into necessities and luxuries and measuring their interest rate sensitivities may be an avenue for future research.

Since cyclicality is the main argument behind the sensitivity of the basic materials sector, other cyclical sectors come into mind such as telecom and information technology. The telecom sector has been discussed earlier, but the information technology (IT) sector is arguably the most cyclical of all the ten sectors in the economy. Yet, it is not significantly affected by changes in the Federal funds rate. This can be explained when we consider the time period used in this analysis. The United States economy just experienced the bursting of an IT stock bubble in 2000. This left IT companies with little capital and investors wary about investing in them. Due to this lack of capital, IT firms were less sensitive to interest rate changes in the economy for a while after the bubble burst. This is why we did not observe significant sensitivity to interest rate changes from the IT sector, despite its highly cyclical nature.

Unexpected policy changes are not significant in explaining changes in stock prices, as can be seen by the results. This result suggests that markets are forward looking and incorporate both expected and unexpected changes in the federal funds rate into their prices. This incorporation leads to the variable being insignificant.

VII. Conculsion

In conclusion, four out of the ten sectors' stock prices respond significantly to changes in the federal funds rate. These sectors are the utilities, financials, telecommunications and basic materials. Specific demand and supply effects present in the federal funds market are the reasons for these sectors' high responsiveness to interest rate changes. Sectors with a large proportion of long term debt, such as utilities and telecommunications exhibit sensitivities to federal funds rate changes. However, for these sectors, the debt/cost effect is dominated over by the revenue effect presented by an expanding economy. Cyclical sectors, such as the basic materials sector, also exhibit sensitivity to changes in the federal funds rate. The direct connection between federal funds rate changes and financial institution revenues and costs make the financials sector sensitive to interest rate changes. The revenue effect also dominates the cost effect in the financials sector. The basic materials sector also exhibits sensitivity due to its cyclicality and the sector's cost and revenue effects, with the revenue effect dominating.

All sector stock prices exhibit positive relationships to changes in the federal funds rate. This positive relationship supports the theory proposed by Keynesian economists and shows a domination of revenue effects over cost effects. However, the industrial production index did not serve as a good control variable for expected future money demand changes. Expected and unexpected changes are incorporated in the stock price, which suggests that the stock market is indeed forward looking.

Avenues for future research would include dividing the consumer goods sector into consumer necessities and luxuries and repeating the empirical tests; and including a control variable that not only controls for actual changes in the money

demand, but also expected future changes. Using a time period where GDP growth is stagnant and observing which effect (revenue or cost) dominates would also make for interesting future research since it would eliminate the time varying sensitivity to interest rates. The analysis could also be repeated excluding the CPIU variable, since it was not significant in the results, and using inflation indexed returns to control for nominal changes in the interest rate.

Also, a measure of monetary policy other than the Federal funds rate could be used, including measures such as the M1, M2 or M3 monetary aggregates, or simply changes in the non-borrowed reserves. Using one of these measures would restrict the analysis to changes in money supply affecting the stock prices, and would automatically control for demand effects.

The financials sector could also be subdivided into its respective components and the analysis could be repeated. This is because different subsectors of the financials sector will exhibit different interest rate sensitivities, i.e. commercial banks will react differently than investment banks, since the Federal funds rate is more directly connected with commercial bank revenues and costs than with an investment banks.

Policy implications, if any relate to the interest rate sensitive sectors. The sectors should be aware of their exposure to interest rate risk and develop mechanisms to hedge against this risk using futures and options contracts. These sectors would need to make sure that their interest rate risk management is asymmetric in case their company is more sensitive to positive or negative changes in the federal funds rate.

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Data Sources:

AT & T Balance Sheet: [http://finance.yahoo.com/q/bs?s=T&annual].

CPI-U: [http://www.bls.gov/cpi/]

Duke Energy Co. Balance Sheet: [http://finance.yahoo.com/q/bs?s=DUK&annual]

Industrial Production Index: [http://research.stlouisfed.org/fred2/data/INDPRO.txt]

Fed Funds Futures: [http://www.grainmarketresearch.com/eod_futures.cfm]

Federal Funds Rate: [http://www.federalreserve.gov/Releases/h15/data.htm]

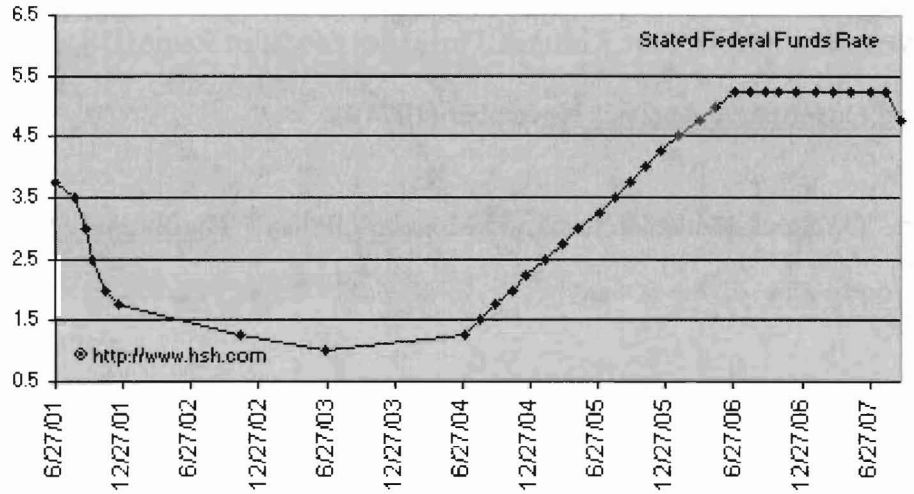
S&P500: [http://finance.yahoo.com/q/hp?s=%5EGSPC]

Sector Stock indexes:
[http://www.djindexes.com/mdsidx/index.cfm?event=showTotalMarketIndexData]

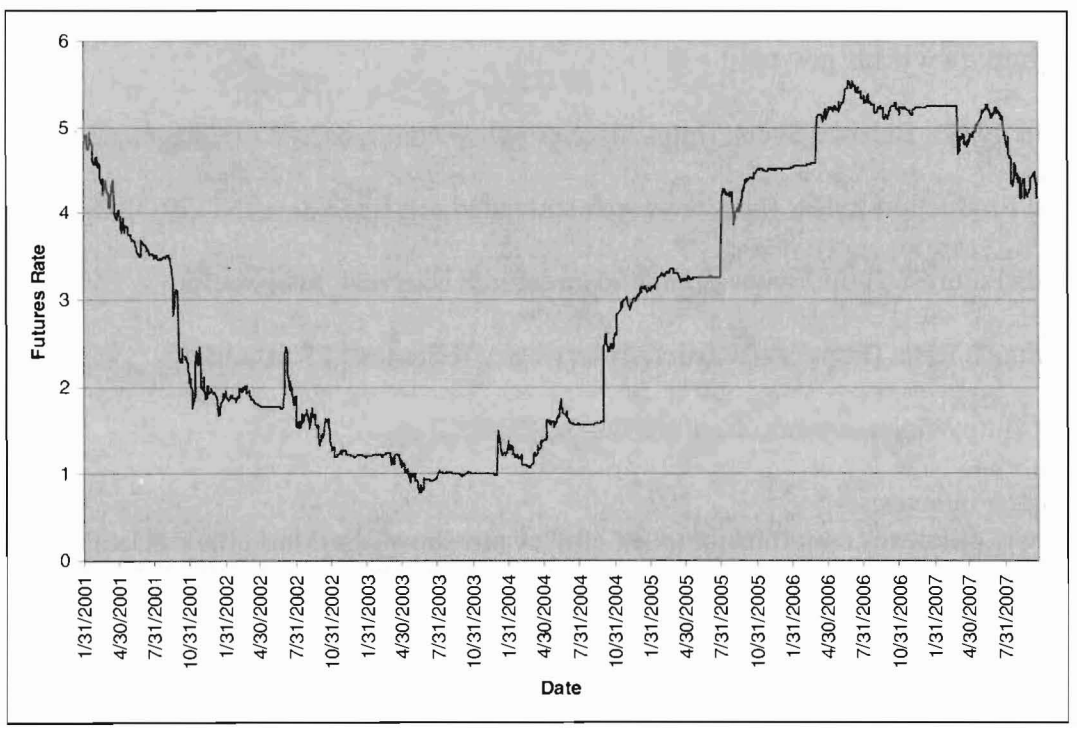
Appendix A

Graphical Representation of Historic Data

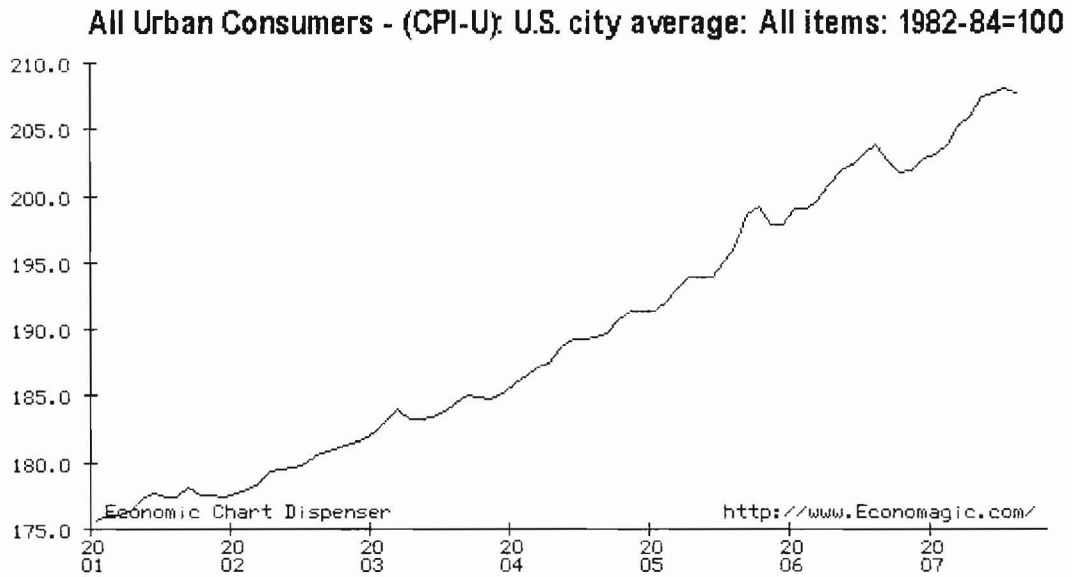
1) Federal Funds Rate



2) Federal Funds Futures



3)CPI



4) Industrial Production Index