Inflation Expectation and Financial Markets

An Interactive Qualifying Project Report:
Submitted to the faculty
of the
Worcester Polytechnic Institute
in partial fulfillment of the requirements for
the Degree of Bachelor of Science
by

_____

Yang   Gao

Date:
August, 2005

Approved by:

_____
Professor Dalin Tang
Project Advisor

1. Inflation

2. Expectation

3. Finance

TABLE OF CONTENTS

Acknowledgement

Various people have contributed to this project. I would like to thank my advisor Prof. Dalin Tang, whose comments and guidance lead me through this project. I would also like to thank librarians at the Gordon Library, especially Christine Drew who has always been patient to all kinds of questions. Lastly, I would also like to thank my roommates Ajay Dave, Isaac Christensen and Nick Lapenta, who challenged and supported me in finishing this project.

Abstract

This project examines the expectation of inflation and its interaction with various financial markets. An overview of behavioral finance was given which illustrates how people form expectations and make decisions. Then the case of inflation expectation was analyzed in an attempt to measure it with an econometric model. How investors perform with inflation expectation measures was investigated. Finally, the impact of technology on market efficiency was analyzed and implications of the findings were offered.

Chapter 1 Introduction

"October. This is one of the peculiarly dangerous months to speculate in stocks. The others are July, January, September, April, November, May, March, June, December, August, and February."

--Mark Twain

Of all the decisions we face in our lives, investment decisions are perhaps the most difficult ones. The readily available news release reflects an ever changing financial world. The free and often conflicting analysis provided by "experts" often confuses people more than they help. Even the most intelligent analysts with rigorous training in finance sometimes make irrational choices and incur big losses.

Human beings are emotional and hence do not make flawless decisions like computers. They do not follow a set of rules and act consistently in all occasions. They are, however, constrained by personal background and prejudice. Furthermore, they often suffer from group thinking. The very process of making investment decisions is such a fascinating subject that leads to the birth of behavioral finance and motivates various insightful researches.

Over the years, behavioral finance has offered valuable new perspectives in evaluating investment decisions. We will survey this fast growing new field in chapter one and specifically undertake the formation of inflation expectation to analyze. We will illustrate the self-enforcing cycle between media, people's expectation and choices.

Backed by theoretical analysis, we will then conduct empirical study to explore how financial markets interact with this expectation in chapter two. We will consider both quantitative and qualitative factors that cause current concerns of inflation. We will measure it with an econometric model, using data of Treasury Inflation Protected Security (TIPS) and Treasury Note yield rates, as well as other readily available data. Some past study has indicated that there exists a correlation between inflation expectation and term spread of yield rates, but it was inconclusive because of the limitation of data. During May 3rd, 2004 to May 20th 2005 Fed has increased the Federal Funds Rate seven times. We believe more convincing results will be obtained with this new data set. This study may provide new insight because TIPS was not introduced until 1997 and from 1997 to 2004 the interest rate was steadily low. With the measure we obtained, we will then investigate how investors perform with this expectation in chapter three. We will also compare the interaction between inflation expectation and currency, stock and oil future market. In chapter four, we will offer implications and future possibilities, concluding this study.

Goals of the project

This project attempts to answer the following questions:

1. How do people form inflation expectation and how can we measure it?

2. Is there a relationship between the expected inflation and financial markets performance?

3. If there is a relationship between financial markets performance and the expected inflation, how do these relationships differ from each other?

4. What are some practical implications of our findings?

Chapter 2 Behavioral Finance Overview

2.1 A brief history of behavioral finance

Behavioral finance or behavioral economics is a relatively young field. It is generally regarded that it has mostly grown from ground in the past 25 years. Behavioral finance has been given more attention in recent years after Daniel Kahneman received Nobel Prize in Economical Sciences "for having integrated insights from psychological research into economic science, especially concerning human judgment and decision-making under uncertainty" [1].

In 1979, Daniel Kahneman and Amos Tversky(1979) published *Prospect Theory: An Analysis of Decision under Risk*, which challenged the orthodox Expected Utility Theory[2]. They argued that people make different decisions according to gain or loss rather than expected financial wealth. Their experiment showed that people make inconsistent decisions when options are only offered in alternative forms. Their paper has inspired fruitful researches in following years, where the process of decision making is investigated from various perspectives. Psychologists have identified following characteristics in people's decision making process [3]:

Overconfidence: First, the confidence level people assign to their estimates are too narrow. Their 98% confidence intervals, for example, include the true quantity only about 60% of the time [Alpert and Raiffa (1982)]. Second, people are poorly calibrated when estimating probabilities: events they think are certain to occur actually occur only around 80% of the time.

Optimism and Wishful Thinking: People often appear to be overconfident about their abilities and choices. Typically, over 90% of those surveyed think they are above average in such domains as driving skill, ability to get along with people and sense of humor.

Representativeness: It leads to three kinds of biases: Self attrition, hindsight bias and sample size neglect. Self attrition describes the fact that people tend to ascribe success to their own talent while blame failures on bad luck. Hindsight bias is the tendency of people to believe, after an event has occurred, that they predicted it before it happened. If people think they predicted the past better than they actually did, they may also believe that they can predict the future better than they actually can. Sample size neglect means that in cases where people do not initially know the data-generating process, they will tend to infer it too quickly on the basis of too few data points. In situations where people do know the data-generating process in advance, sample size neglect leads to gamblers' fallacy effect. If a fair coin generates five heads in a row, people will say that "tails are due".

Belief perseverance: once people have formed an opinion, they cling to it too tightly and for too long. First, people are reluctant to search for evidence that contradicts their beliefs. Second, even if they find such evidence, they treat it with excessive skepticism. Some studies have found an even stronger effect, known as confirmation bias, whereby people

misinterpret evidence that goes against their hypothesis as actually being in their favor.

__Anchoring__: When forming estimates, people often start with some initial, possibly arbitrary value, and then adjust away from it.

__Availability biases__: When judging the probability of an event – the likelihood of getting mugged in Chicago, say – people often search their memories for relevant information. While this is a perfectly sensible procedure, it can produce biased estimates because not all memories are equally retrievable or "available". More recent events and more salient events – the mugging of a close friend, say – will weigh more heavily and distort.

They also indicated these together formed psychology base of behavioral finance.

Thaler and Barberis also argued that another base of behavioral finance is limit to arbitrage. Some other scholars believe that limit to arbitrage is where psychology tools are used for. Daniel Kaneman introduced the idea of "bounded rationality" with convincing experiment result. They investigated the human judgment process and identified "systematic errors in the casual statistical judgments of statistically sophisticated researchers"[4]. Their study lead to the prediction of long-lasting arbitrage position and challenged the Efficient Market Hypothesis (EMH). Thaler (1994) and other researchers subsequently discovered a series of market abnormalities, which supported the theory that the irrationality of people cause persistent market inefficiency.

2.2 The origin of expectation
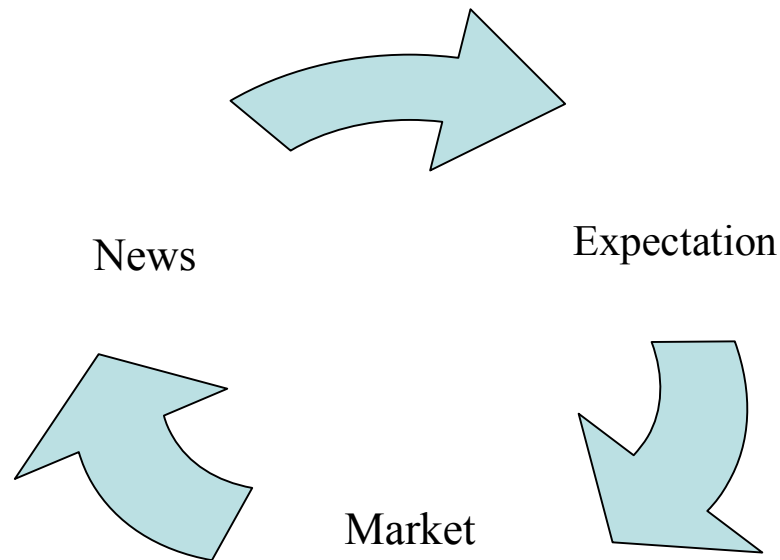
Figure 2.1 Expectation in a feedback loop

The picture above illustrates the interaction between news media, personal expectation and market performance. It is a self-enforcing feedback loop in the language of system dynamics. We will begin our analysis with the interaction between news media and people's expectation in this section and then go through the loop in section 2.3 and 2.4.

Instant news has been more and more convenient to access with the help of internet and cable TV. In the past, people have to open their financial newspaper and squeeze their eyes to find tiny quotes. What are worse, investors can only access previous days' quotes on a daily newspaper. This one day lag can be expensive in a fast changing financial world. By contrast, nowadays even non-professional investors can easily obtain instant quotes of stocks and bonds online for free. Working in a financial company, I found that stock quotes are even available on a mini television in elevators.

The progress in information distribution greatly facilitated people to collect information, as it did in the case of the May 11, 2005 While House evacuation. When news burst out that a plane was flying towards the White House and the alarm level was raised to red, the Dow Jones Industrial Average tumbled 100 points within hours. It then raised more than 100 points to finish as a 19 points net increase when alarm was cleared [5].

Reports of news events with market sentiment like this are not uncommon in our daily life. If one opens television at diner time, one can easily find a number of financial news programs such as Mad Money and Nightly Business Report (NBR). Most of these news reports begin with a summary of daily performance in stock, bond, foreign exchange and commodity markets and end with repeating the major stock indices' net change. Compared to other news report, a major feature of these reports is that reporters tend to relate major business events with market variations. For instance, we can often hear comments such as "Stocks fall on news of lower retailing growth…" or "Stocks rise on lower oil prices…" Sometimes these analyses even conflicts with each other. For instance, comments like "Stocks fell even on news of lower oil price…" are not uncommon.

A fundamental fact that distinguishes these reports from other news report is its lack of objectivity. Most other news reporters often lay down facts and figures first and then offer a follow up explanation, sometime by interviewing an expert. On the other hand, although business news reporters also quote from *anonymous* analysts, they often decisively relate market performance with major events in the first time. Comments such as "Stocks rally on a stronger- than-expected GDP growth" are often offered by reporters

without any quotation. This practice in business news creates an impression for the unsophisticated audience that there is definitely correlation or even causation between certain business events and market performance. As R. Shiller noted in *Irrational Exuberance*,

> *"...there is a shortage within these accounts of relevant facts or considered interpretations of them. Many news stories in fact seem to have been written under a deadline to produce something—anything—to go along with the numbers from the market. The typical such story, after noting the remarkable bull market, focuses on very short-run statistics."*[6]

The impression from various news resources plays an important role when people form their expectations. This is because when people hear similar news again, they tend to expect similar outcomes. For example, new concepts and new versions of a popular product are likely to attract consumers. Therefore, when one hears that a company's new product is welcome in the market, one cannot help but expecting the company will have higher-than-expected profits and hence a new high stock price. For instance, when oil futures' price climbs, the stock price of energy companies such as Exxon Mobile often increases accordingly. So next time when people hear news on oil shortage, they will *naturally* expect oil futures price to go up and consequently deduct that energy companies' stocks are undervalued. They will then bid up energy companies' stocks and then conclude they made a brilliant prediction.

It is not difficult to see there is also a self-enforcing feedback loop in the above process. First, people believe that news on higher oil prices will lead to higher prices of energy companies' stocks by past experience. They subsequently become a part of the

vast market force of demand of these stocks. They bid up prices of energy stocks, which in turn enforces their experience.

Besides business news from various media, people also gather information from their personal life experiences. For instance, people often prefer companies that offer their favorite products or services. A friend's father likes to drink a certain kind of beer. So when he started investing, he first bought the beer company's stock. It turns out that the stock did much worse than he expected. Similarly, Warren Buffet invested in American Express even when the company was in trouble because he observed that people continue to use American Express's card. [7]

In addition, people sometimes believe information from obscure sources such as rumors. For instance, when rumors came out that Apple computer was going to change its central processor supplier from IBM to Intel, although official spokesperson stated that the alleged change was a rumor, IBM's stock went down while Apples' stock went up. [8]

Recommendations from financial analysts also significantly affect people's expectation. When business reporters interview financial analysts, they often ask them to recommend a couple of good buys and if they own the stock personally. The success of Mad Money, a program on which people ask analysts' opinions on their own stocks, also shows people's eager to consult alleged experts. Diverse financial books, especially those on investment strategies have been increasingly popular in recent years. In 2004, 1770 financial books are published.[1] These books range from academic research to "investment for dummies" and they satisfy people's desire to learn from and to be confirmed by experts.

---

[1] In courtesy of Christine Drew, Gordon Library, Worcester Polytechnic Institute.

2.2.3. The rationality of these expectations

A number of biases played a role in forming the above expectation. As people who own the stocks want to make more capital gains and people don't own the stock want to take the speculative opportunity, they have a wishful thinking bias. They wish they will just be as right as right as last time and they expect their stock will go even further this time. They also suffer from hindsight bias in forming this expectation. After making profits in their stocks of energy companies last time, most investors find it is just too hard to stop expecting that stocks will go even higher when the gas price surges this time. Another bias in this formation process is the availability bias. Investors often fail to remind themselves of unfavorable experience they have with energy stocks and wish those experiences are only outliers or exceptions. Hence even though I do not own any energy stocks, I found it *emotionally* difficult to accept that stocks went down with a fall of oil prices. Similarly, when Robert Shiller tried to convince people that stock prices are too high, investors told him that "You *must* be wrong, because stock price can *only* go higher."[9]

More generally, another two biases also play a part when people collect information to form expectations. The first is the sample size bias. When people listen from one reporter or an expert, they often fail to question their credibility. They tend do believe one analysts' idea is the whole market's feeling. As R. Shiller noted:

> *Even if there is no manipulator fabricating false stories and deliberately*
> *deceiving investors in the aggregate stock market, tales about the market*
> *are everywhere. There are still many people (indeed, the stock brokerage*
> *and mutual fund industries as a whole) who benefit from telling stories*

that suggest that the market will further. There is no reason that for these

stories to be fraudulent; they need only emphasize the positive news and

give less emphasize to the negative. [10]

In the other case, my friends' father bought the beer company's stock without any financial analysis; he essentially took his own preference to be the market's preference. Another bias that investors often suffer from is group think. In an ever-changing financial world, one can never be certain with future market performance. This uncertainty makes most investors aggressively seek so-called analysts' confirmation. For instance, a lot of people aggregate various agencies' trade recommendation (buy, hold, or sell) together. They count these three kinds of "votes" from analysts and base their decisions on the result. However, in doing so people ignored the fact that analysts, like other human beings, also seek confirmation from their peers and often fail to confront the majority opinion.

2.3 The emotional decision

2.3.1 The character of investors

People make investment decisions based on their expectation. This is because they pursuit returns and returns can only be realized in the future. Every finance text book tells us that stock prices reflect a company's future earnings and its ability to grow. In the future market, people trade commodities, currencies, and stocks that will only be delivered much later. The price of these instruments fluctuates even more with various people's expectation and they fundamentally affect the instant markets. After exploring the formation process of expectation, we will analyze how people perform on their expectations in this section.

As our society is aging and people's life expectancy continues to grow, nowadays people are more conscious of their retirement. The emergence of various pension plans such as 401(k) almost makes everyone an investor. Staring in 2006, people can even invest their money in tax-sheltered health account. Therefore, people of diverse professions, of different ages and of education backgrounds are directly or indirectly participating in various financial markets on a daily basis. According to their investment approach, we can divide them into two groups, short-term traders who speculate in markets and long-term investors who buy and hold. Albert Hass offered a classic description of their characteristics:

What qualities would we expect to find in a stock market player who will

turn in a top performance? The successful long-term investor will require

the fewest qualifications; the short-term trader who succeeds will need

many, and must not be encumbered with any serious handicaps. The ideal

prospect will have decided for him that he wants to be in the market, and that he can afford it in terms of money, time, and emotional involvement. He has chosen the game that suits him best, is decisive, and has the courage to take action and pursue it unless circumstances change materially. He can distinguish between information and conjecture, rumor, or half-truth. He is not easily disturbed by the short-term behavior of his stocks, the market, or by other people's opinions. His convictions are firm; he will not sell a stock merely because it drops, nor take a profit prematurely if his stock performs well. Still, he is on guard to avoid becoming entrapped by greed and is quick to recognize error, will accept it and cut short his loss. He has struck a workable balance between gullibility and cynicism. He has humility. If a trader, he makes a continuing effort to keep himself in rhythm with the market. He is aware of the market's potential rewards and risks, and is usually relaxed about his market activities. He expects no more of his stocks than they can provide—a means to make money. [11]

As we can see from the above paragraph, to be a short-term investor is by no means easy. But since to be a long term investor requires a discipline to keep hands off when market turns down, most people end up to be short-term investors. We will return to this point in Chapter 5.

2.3.2. The trading process

To understand the how investors make their decisions, we will analyze the trading process after a brief review of their character. More specifically, we will take up the stock market for our analysis.

A company launches Initial Public Offering (IPO) of its stocks to raise capital and it offers returns to investor in exchange. The return usually in two ways: dividends and capital gains. A company usually offers dividends once a year. It can decide how much dividend per share to offer based on its earnings and future investment opportunities. Usually companies will retain part or even all of its earnings for future growth. Certain companies like Microsoft do not offer dividends at all.[2] Hence dividends are often far smaller on a per share basis compared to capital gain. Capital gain is the surplus of sales price over purchase price. Companies often retain their earnings and sometimes also buy back its own stocks to raise its assets per share at the end year; the stock price will then go up. Compared with dividends, capital gains can be realized at any time investors want, because stock prices fluctuate every trading day. Short-term investors follow market movement closely because they focus more on capital gains.

In the trading, buyers and sellers offer their bids respectively and specialist match these offers in the best possible way. The fundamental law of demand and supply applies here as well: if there are more investors who want to buy a certain stock than those who want to sell, the price will go up. It is in this auction process that stock prices move up and down. Essentially, stock prices as determined by every participant. This is an interesting paradox given that people often feel stock prices are random and uncontrollable.

---

[2] Microsoft offered a huge dividend in Jan. 2005, but it didn't offer any dividends in the past.

2.3.3 The decision process

Since most short-term investors look for capital gains, they are constantly seeking the "right time" to buy or sell. A typical scenario would be that some people, based on various either analysis or just intuition as discussed above, decide a company's stock is a good buy. They subsequently bid the price of a stock up. Speculators who follow market movements will also decide the same stock is promising, or "undervalued" and starts to buy in this stock. The stock's price is then pushed even higher as more and more people jump in to bid for it. Through this feedback process, the stock's price climbs higher and higher and at some point, people will start to sell.

One might decide to sell simply because he gets into the market early enough such that he is satisfied with the profit. For instance, "Google falls on some profit taking…" is often heard on television. Psychologists have found that people are more risk-averse when facing gains than when they are facing losses. D. Kahneman and A. Tversky conducted the following experiment: they ask people to choose between

A. *50% win 1000, 50% win 0;and*

B. *450 for sure.*

Surprisingly, most people choose B, which contradicts with the orthodox theory that people make decisions to maximize expected utility.[12] Hence they will sell off early on and sometimes even though the price is still rising.

The Prospect Theory also predicts that people make decisions based on comparisons. For instance, if I tell you that a company's profit increased $1.5 dollar in the most recent quarter, what will one think? One might think that the company did pretty well and some others might even bet on the stock of this company is going to rally.

However, what if I further disclose the fact that the company missed Wall Street analysts' profit projection by two cents per share? Most investors will immediately change their decisions to just the opposite: sell or short the stock because it "underperformed", even lacking the knowledge of industry average or any other statistics. In fact, this is exactly what happened to Nike at the end of second quarter of 2005.

It might also because past experiences tell us that the stock cannot climb infinitely, so one believes sooner or later the price curve is going to turn down. As discussed earlier, the Representativeness bias just predicts this kind of behavior. After the market increases consecutively for a few days, most analysts will expect market is "due" to drop.

In addition, one might decide to sell because colleagues or friends of one have sold or because one has recently obtained some negative inside information about the company. Moreover, it might because his sophisticated investment advisor, after conducting comprehensive research and financial analysis, signaled a "sell" recommendation. All these possible causes lead to the invariable consequence: to cash out the stock.

But before investors finally click the button or make the call, they need some justification of their decision. They will justify any movements by aggressively seeking related news and analysis, which suffer from various biases presented earlier and boost their confidence.

This common scenario will repeat itself later on. It is during this feedback process, the price curves cycle up and down and move forward, leaving millions people running after the crest. Various analysts, especially those who are called "chartists" spend most of their time trying to decipher market psychology, or trends. For instance, they invented the

trading technique "swing trading", in which they determine a channel of stock price based on past experience. They then draw two lines on the price chart to specify the best estimate of highest price and lowest price. Trading becomes easy after the range is fixed. When prices jump out of the upper bound, they sell stocks they own and when prices drop below the lower bound they consider to buy in a new stock and wait for the next peak.[13] Indeed, many online brokers offer program to implement such a strategy automatically.

To conclude, trading in the short run is often emotional rather than rational. As Robert Shiller pointed out

> *Conceivably, a bubble might exist only because people think that there is a temporary bubble and want to ride with it for a while. ...Feedback loop dynamics can sometimes generate complex and even random behavior. The so-called random number generator in some computer is simply nonlinear feedback loops.* [14]

2.4 The sentimental media

We have just analyzed how investors collect information, form expectation and then make decisions on expectation. After going from News to Expectation and from Expectation to Market, we will go back to News in this section, complete the feedback loop we illustrated at the beginning of this chapter.

We hold it evident that news media play a pivotal role in the market feedback process. They propagate miscellaneous information for investors to judge, to analyze and to decide. News media then record and reflect decisions people make, actions people take, as well as those delighted and depressed faces. News media starts the loop and reinforce it.

News, especially business news has expanded at an astonishing speed in recent years, mainly due to the advance of technology and a persistent market boom in the 1990s. The emergence of news channels such as CNBC made it possible to keep updated instantly of any new market movements, macroeconomic indicators' change, professional analyses or congress testimony. It is amazing to see that on a single screen, a chart of various market indices is presented in the middle, individual stocks' variation is showed in the right corner and a reporter stands in the left corner of screen, trying to capture traders' sentiment. However, for most investors, this is far from enough information.

Internet made it possible to review different TV news and newspapers instantly and virtually from every corner of the world. The distribution of news is hence more diversified and efficient. Internet by far facilitated reporters to get tuned to each other's observations and comments. Indeed, most reporters constantly reach out to be aware of what happening in other parts of the world and what impacts they may have impact in

domestic market. With globalization, an international perspective often proves to be valuable to investors. Since reporters are able integrate various resources into their own news, they multiplied the impact of news media on investors.

A typical example would be the trading panic on May 11th, 2005 caused by an error in translation. A reporter for the China News Service put together a story of potential impact of a reevaluation of the Chinese currency. This piece of news is then captured by the People's Daily online, one of China's official newspapers. When translated into English, the original story was distorted to the Chinese government is going let their currency appreciate at a specific percentage in the coming month. Bloomberg use search software on the internet to gather all kinds of news. When they obtained this piece of information, eager to, make a headline they sent it out without any confirmation from Chinese officials. It is estimated that about $2 billion was traded within minutes that the Bloomberg issued the story. [15] This story clearly demonstrates that how closely traders scrutinize any tiny movement in the market through internet.

In addition, News media will certainly notice any significant movement in the market and general economy and report it as soon as possible. For example, "the Dow dropped 150 points, the biggest one day drop since last year…" will be heard every once in a while. As Shiller noted, people like here new change, be it the biggest boom since last week, last month or last year.[16] These significant fluctuations, complied with "professional analyses", will then be presented to investors for further reference. In essence, news media is a mirror where investors can see their own actions and analyze them.

Furthermore, people often like to follow analysts' recommendation and buy hot stock in the news. News media certainly understand this need and constantly provide viewers with this information. To demonstrate, I would like quote an investment decisions from another IQP[17]:

> The main reason we took a chance by choosing ISON was the fact that they used weapon detection technology. In these times of terrorists and the war in Iraq, a company like this could do quite well for themselves. …

Clearly, the comprehensive news coverage of war on terror played role in this decision.

As mentioned earlier, a lot of times market sentiment depends on comparison. News media nearly always compare the status quo with past experiences since people tend to believe that what happened in the past will at least provide some indication for future. When it comes to the end of a quarter, the summary of a stock or the overall market will now only include change from last quarter, but change compared to the same quarter last year, change from historical average, etc..

In conclusion, by summarizing the market in a way that satisfies people's psychological needs and by facilitating the exchange of information, news media greatly reinforced the loop.

Chapter 3 The Inflation Sentiment

In last chapter, we offered an overview of the interaction between news media, people's expectation and market performance. We will focus on inflation expectation in this chapter and illustrate the feedback loop we constructed in following chapters.

3.1 Contemporary concerns

During 2000-2001, the American economy experienced a mild recession triggered by bursts of dot com bubbles and the September 11 tragedy. To help economic recovery the Fed decreased the Federal Funds Rate eleven times during 2000. The Federal Funds Rate dropped dramatically from 6% to 1.75% and has stayed at a historically low level since. A low interest rate level encourages consumer credit spending and business investment, especially in a credited based society like the United States. The GDP growth and business environment has recovered since 2003 and inflation measures such as Consumer Price Index (CPI) have accelerated. The Fed then declared the inflation control its top priority.

Since then, the investment world's sentiment on inflation has been increasing accordingly. TV News, economic magazines and newspapers also shifted their worry from unemployment and deficient demand to inflation measurers. The study noted that three factors appear most often in economic columns of newspapers and business news on television: the twin deficit, the weak dollar and the high oil price. Although this is far from a comprehensive list of contemporary causes of inflation, their high visibility makes them major causes of investors' worry. A remarkable *reported* change in one of these factors can often convince investors to take actions with their investment. Almost

everyday we can hear on Nightly Business Report or read on the Wall Street Journal: "A lower oil price helped the Dow to climb…" Hence we will mainly focus on these three factors.

Most economists, whether Keynesians or Monetarists agreed on that a persistent federal budget deficit is not healthy for economy. In her recent speech, Hilary Clinton described the record 412 billion budget deficit as a "birth tax" on every American citizen. When the government uses more money, it defers people's spending and prevents the market from allocating resources efficiently. Moreover, a high level of budget deficit itself leads to substantial interest cost. We all know personal loans will keep growing even if we don't borrow new credits. The federal government faces similar difficulties in reducing its debt. Since the federal government finances its budget deficit mainly by issuing treasury bills and a substantial amount of these public debts are held in foreign investors central banks reserves. These public debts are also counted as foreign investment, which contributes to a high level of trade deficit. This close link between the two deficits qualifies them as a twin. Without continuous and instant effort to reduce debts, the twin deficit will grow to an unsustainable level, which makes people lose confidence in paper money, as it did in the case of hyperinflation as in Germany and China in history. In a word, the twin deficit causes inventor's concern of future inflation.

The dollar has been consistently weak since 2002. Like any other financial instruments, the value of a currency is determined by the basic rule of market supply and demand: when more people sell dollar instead of buying it, it depreciates against other currencies, most remarkably the euro in the past two years. As mentioned before, this suggests that investors overall are somewhat pessimistic about the U.S. economy.

Furthermore, the fact that more and more U.S. Treasury Securities are held in foreign investors' hands is especially worrisome. As the dollar depreciates sharply against the euro in the past two years, central bank regulators have been increasingly cautious about the future value of U.S. currency. For example, in diversifying their portfolio, Korean central bank has already begun to sell some U.S. dollar holdings, which triggered some speculators' selling. Analysts worries that if countries with huge U.S. dollar reserves like China begin to dump dollars, it could well lead to a fad of selling just like the 2000 Internet bubble and other stock crashes in history. This could be disastrous to a big importing economy like the U.S because the depreciation will lead to more selling and will lift the twin deficit even higher. Since depreciation of currency is the ultimate result and representation of inflation, investors often draw inferences of inflation from variations of U.S. dollar.

Soaring oil prices contributed to our high trade deficit since more than half of oil in the U.S. are imported. Oil is a very limited natural resource and has been diminishing at an astonishing pace during past twenty years. To make matters worse, economic growth often requires higher demand in oil. This is especially true in developing countries without good reservation technology. As many economists have pointed out, the fact that fast growing Asian economies need more and more oil will only lift the price higher. The increasing conflict between peoples' unlimited desire for oil and the limited supply has sent oil price higher and higher. From basic economic principles, we can deduce that a high price will offer strong incentives to increase oil supply and to decrease oil demand by developing new energy resources, as Fed chairman Alan Greenspan noted in his testimony.[18] In the short-run, however, it is a real concern because it can be very

volatile and often causes market sentiment. Speculators bid the summer oil future even higher than immediate delivery price. In addition, the demand for oil is very inelastic in short-run. From gasoline to plastic bags, petroleum industry plays a crucial role in people's daily life. For instance, consumers can choose to defer the purchase of an SUV, but they cannot choose to change their SUV when oil prices increase. Indeed, both General Motor and Ford Corporation's sales are hurt by high oil prices but the way people shop and drive has not changed.[19] Therefore, an increase in oil price will definitely accelerate not only the CPI but even the core inflation index excluding food and energy, causing worries of inflation and Fed's increase of Federal Funds Rate.

As pointed out earlier, these three factors are closely linked together rather than isolated from each other. For instance, since the Iraq war in 2003, oil price almost tripled and the dollar tumbled by about 30% against euro and other major currencies.
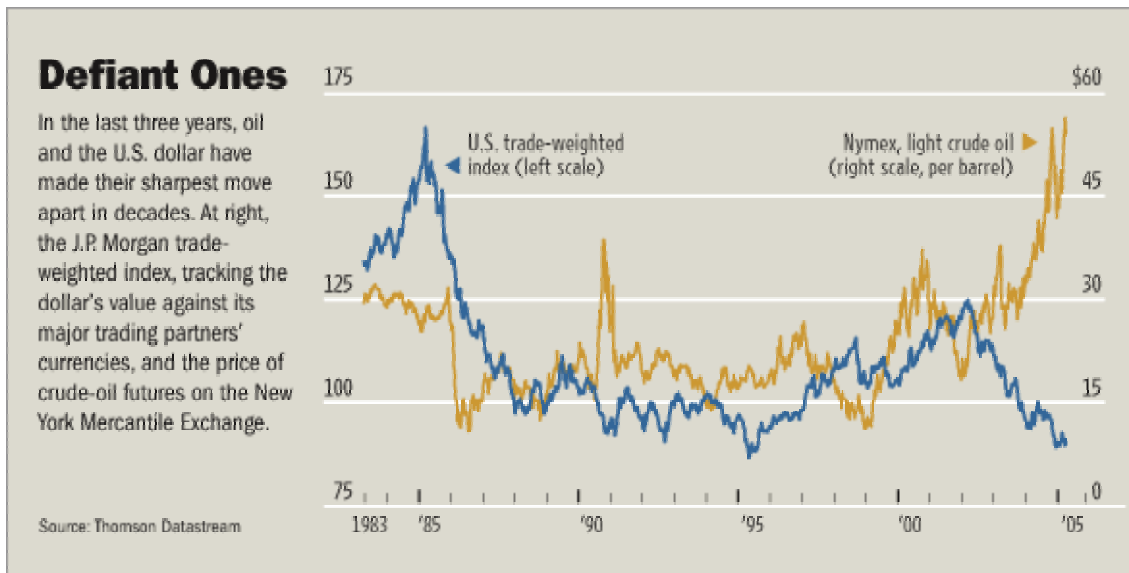
Figure 3.1 Oil price and U.S. Currency (Source: The Wall Street Journal, Apr.24, 2005)

We conclude this section by summarizing several self-enforcing circles discussed above:

- High budget deficit->high interest cost->high budget deficit

- High budget deficit-> weak dollar->high trade deficit

- High oil price-> High Trade Deficit-> weak dollar

- With some help of system dynamics, these relationships could be presented in a more rigorous manner.

3.2. Measure the expectation of inflation

After a review of major contemporary concerns of inflation, this section attempts to measure these concerns using both quantitative and qualitative analysis.

3.2.1 The qualitative measure

As mentioned earlier in 2.4, media plays an important role in the formation of expectations. Everyday macroeconomics indicators as well as analysts' comments are presented to investors on television, newspaper, etc.. Therefore, this project will primarily take economics news and analysis p quantitative measures of inflation expectation. An earlier Princeton study identified three kinds of news as potential causes of inflation sentiment: news on budget deficit, news on FMOC meeting and news on oil prices. The study also noted the difficulty of investigating effects of these three kinds of news. This is because building significant relationships requires regression analysis, which obviously

cannot be done with qualitative factors.[3] The study also offered an excellent way to look into the interaction between news and people's expectation by quantifying these measures.

The Princeton study used adjusted monthly receipts for the three previous years and seasonally adjusted tax employment data for the three previous years to represent budget deficit news. Although this is a creative approach, the result is not conclusive. We believe that this is mainly due to federal government receipts is not a highly visible indicator on media. More often people will just act on the single budget deficit number because of its much higher accessibility. The fact that federal budget deficit is steadily decreasing may also cause the result inconclusive. On the other hand, as we analyzed in the last section, the twin deficit do account for a large part of contemporary concerns. We will relate some news to daily change of inflation expectation in the way the author did.

We agree with the author that FOMC meeting announcements plays a crucial in forming inflation expectation. As often noted by the media, investors scrutinize the minutes word by word and react to minutes. A typical example would be the Fed's statement revision on May.3rd and the market disturbance.[20] The Fed increased federal funds rate by 0.25% as most experts expected, but it omitted "Longer-term inflation expectations remain well contained" unintentionally. Investors interpreted the omission as a future 0.5% increase and acted on this fear. The crude oil futures plunged 2.8% to a two and a half month low. Just before the end of trading, the Fed added back the sentence and the bond market gained slightly, which means yield rate fell accordingly. This phenomenon also showed that people do quantify qualitative information through

---

[3] Treasury Inflation Protected Securities: Measuring Expected Inflation and the effects of Current Events on Expected Inflation. This paper will be referred to as the Princeton study subsequently, since the author is an unknown Princeton student.

complicated process in their minds. The Princeton study used the 10 year to 3 month term spread of ordinary treasury securities to represent the Fed's monetary policy and obtained significant results. This study used ten year to one month term spread of treasury securities and achieved similar results.

The Princeton study also used crude oil future price and weighted dollar exchange rate as exploratory variables. We will look into the interaction between various financial markets and the inflation expectation systematically in chapter 4.

3.2.2 Quantitative measure

The principal qualitative measures this study will use is derived from the Treasury Inflation Protected Security (TIPS) yield rates and the Treasury Note (T-Note) yield rates.

The yield rate of a financial instrument can often be decomposed in the following equation:

$$\text{Yield} = \text{DRP} + \text{LP} + \text{RI} + \text{IP} \tag{3.1}$$

where DRP is the default risk premium, LP is liquidity premium, RI is the real interest rate (or real rate of return) and IP is the inflation premium. The default risk is the chance that an issuer fails to meet its liabilities. For instance, a company may fail to pay the coupon it promised on its bond, or, in some cases, even the face value of the bond. Hence for corporate bonds, the default risk premium is usually a substantial component. However, for both TIPS and T-Notes, default risk premium is close to zero since the federal government has the best ability to pay any debts it issues. Debtors usually need to pay a liquidity premium as part of the return because investors may not easily transfer

their investment into cash. For example, an investor who puts money into a house cannot easily get cash back and invest in other instruments with the same yield. To contrast, treasury securities are in general very liquid.[4] Treasury securities are the most common investment choice. Most investors hold treasury securities as part of their portfolio for their low default risk. Intuitional investors like pension funds and insurance companies are required by law to invest in low default risk bonds like treasury bonds. In addition, the Fed expands and or contracts money supply by buying or selling U.S. treasury securities. Therefore, treasury securities are actively traded in the open market each day, which means investors can easily sell their bonds to get cash[5]. In conclusion, for purpose of this study, we will assume that both default risk premium and liquidity risk premium are zero.

For short term treasury bonds, or T-Bills, the maturities of the bond are usually within a year and hence the inflation risk premium is generally low. On the contrary, a ten-year T-note will subject to a much higher inflation risk. For instance, assume the CPI will be 3% on average during the next ten years; a $1,000 face value bond will have a buying power of $744. The uncertainty of inflation is hence long-term investors' biggest worry. In 1997, Treasury Inflation Protected Securities was introduced into the market. The TIPS are offered at maturities of 5, 10 and 20 years. Unlike other long-term bonds, its face value will be adjusted semiannually according the Consumer Price Index (CPI), which effectively protects investors from inflation.

This feature of TIPS also provides researchers a very good way to gauge inflation. Because it is adjusted for inflation, the yield rate of TIPS is often considered the real

---

[4] TIPS is a little less liquid, we will come back to this later.
[5] Tax laws and transaction cost discourage frequent trading of individual investors.

interest rate (RI).[6] According to the principal of equivalence, the price of the bond, which is the present value of the cash flows, is obtained by discounting the face value and the interest (coupon) payments. Coupon rates of TIPS and T-notes are determined by the bond issuer, the U.S. Treasury Department. Investors multiply the coupon rate by the face value of a bond to obtain the value of each coupon payment. Discounting the coupon payments and a desired return rate, investors will obtain their prices and offer bids accordingly. The market yield rate is determined by auction processes in the open market, which reflects each investor's desired real return or return containing inflation premium. The hiding inflation premium component will be revealed by the equation:

$$\text{T-Note yield} = (1+\Pi)(1+RI) \tag{3.2}$$

where Π is expected inflation rate. In the following, we will then obtain various inflation expectations by simply dividing T-note yield rate to TIPS yield of the same maturity.

The Princeton study also considered the effects of tax on the yield rate of TIPS. The study assumes 30% tax rate for all the coupon income and principal adjustments and multiply each cash flow by 0.7. It then equates the price of a 10-year T-Note and the price of a 10-year TIPS bond to solve for inflation expectation. Admittedly, the special tax method of TIPS does have some impact on people's decision of returns.[7] However, we believe professional investors will take tax on the interest income into consideration when offering their bids. Another problem is the tax rate on capital gains, which is the principal adjustment, is different from that of interest income. In addition, as mentioned above, market yield rates are derived from price offerings, not the other way around. Therefore, use yield rate and force the price of two bonds to be equal to solve backward

---

[6] The lagging indexation effect and tax law still keep some inflation risk, we will come back to in 3.3.
[7] We will come back to this in 3.3.

is not an appropriate way of using raw data. It is also artificial because represent people may have different preferences over different securities. For example, some highly risk adverse investor may choose TIPS even though returns are the same. Furthermore, the algorithm is based on the proposition that if there is difference between the two bonds, people will bid up the lower priced bond. The limit to arbitrage theory mentioned earlier seriously challenges this assumption. In conclusion, we believe that our approach will be sufficient to attain a reasonably accurate quantitative measure of the inflation expectation.

The study used above approach and calculated both inflation expectation and percent change of it on a daily basis from May 3, 2004 to May 20, 2005. The result is summarized in Appendix 1. It is worth noting that not all days with significant variations coincide with major news. Shiller suggested it is probably because some news only caused people's attention to look back into other news.[21] Below is a graph of daily percent change.
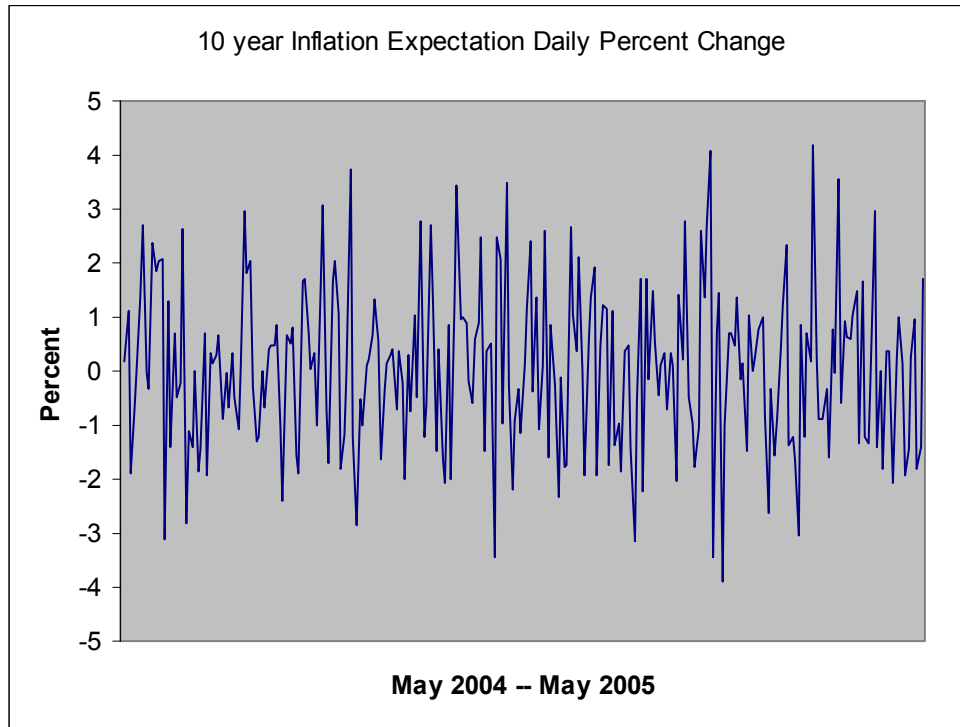
Figure 3.2 10 year Inflation Expectation Daily Percent Change

The author of the Princeton study acknowledged that their study experienced only one Federal Funds Rate change. Compared to the Princeton study, this study has far more experiences of interest raise and somewhat more observations. As mentioned in the introduction, since the TIPS went on the market, the horizon we covered is the only period that the Fed increased interest consecutively. The Princeton study also noted that in a lot of days during their study the inflation expectation is unchanged.[22] They further noted that these days are very troublesome because the study cannot show Fed meeting has any impact on inflation expectation, nor can it show the meeting does not have any impact.[23]

Our study tracked the Fed meeting minutes release from May 2004 to May 2005 and results are summarized below. Dates with Federal Funds increase are in bold.

Date	10 yr TIPS	10 yr T-Notes	Pi_10 year	10 year Pi Daily Percent Change
5/4/2004	2.10%	4.56	2.171429	0.1829076
5/6/2004	2.15%	4.63	2.153488	-1.901831206
5/13/2004	2.18%	4.85	2.224771	-0.046536365
6/30/2004	2.10%	4.62	2.2	2.978723404
7/1/2004	2.04%	4.57	2.240196	1.827094474
7/8/2004	2.02%	4.49	2.222772	-1.210121012
8/10/2004	1.90%	4.32	2.273684	-1.721593704
8/12/2004	1.81%	4.27	2.359116	2.045483747
8/19/2004	1.76%	4.22	2.397727	3.731463572
9/21/2004	1.80%	4.05	2.25	-0.491400491
11/10/2004	1.75%	4.25	2.428571	-1.089902203
11/12/2004	1.71%	4.2	2.45614	1.135190918
11/18/2004	1.64%	4.12	2.512195	-1.089902203
12/14/2004	1.62%	4.14	2.555556	1.362179487
12/16/2004	1.64%	4.19	2.554878	-1.927664142
1/4/2005	1.78%	4.29	2.410112	-3.139692406
1/11/2005	1.76%	4.26	2.420455	-0.135092181
2/2/2005	1.70%	4.15	2.441176	-1.764705882
2/23/2005	1.64%	4.27	2.603659	1.354539769
3/2/2005	1.69%	4.38	2.591716	0
3/22/2005	1.87%	4.63	2.475936	-1.618443886
3/24/2005	1.90%	4.6	2.421053	0.833428474
4/12/2005	1.73%	4.38	2.531792	3.547444307
4/19/2005	1.62%	4.21	2.598765	1.029288461
5/3/2005	1.64%	4.21	2.567073	-1.829268293

Table 3.1 Expected Inflation Change on days of FOMC Meeting

3.3. Regression models and conclusions

We calculated expected inflation rate using daily yield rates of 10-year TIPS and 10 year T-Notes published by the U.S. Department of Treasury. We chose the 10 year yield rates because it is generally considered a benchmark for investors and it is the most closely followed by economists. We subsequently used the expected inflation as the Y variable, the 10 year to 1 month term-spread of treasury security yield rate and the previous days' inflation expectation rates as X variable to perform a multiple regression. The study achieved encouraging results, which is summarized in the table below.

SUMMARY OUTPUT

Regression Statistics

Multiple R	0.968283
R Square	0.937571
Adjusted R Square	0.937091
Standard Error	0.035683
Observations	263

ANOVA

	df	SS	MS	F	Significance F
Regression	2	4.971715	2.485857	1952.376	2.5E-157
Residual	260	0.331044	0.001273		
Total	262	5.302759			

	Coefficients	Standard Error	t Stat	P-value
Intercept	0.305701	0.083884	3.64435	0.000324
Previous day's PI	0.889478	0.029907	29.74167	1.18E-85
10 year to 1 mon spread	-0.0167	0.005855	-2.85263	0.004684

Table 3.2 Regression Summary

As we can see from the table, the econometric has a very high significance level. We are more than 99% confident that our result in valid. The adjusted R- square is 93.7%, which indicates that our model can explain 93.7% of the variation of the inflation expectation. The previous inflation expectation has a coefficient of 0.8894 and a significance level higher than 99%. The term spread also has a significance level higher than 99%, and a coefficient of -0.0167.

Before we draw any inference from our findings, we will note some limitations of our approach as promised earlier. First, since TIPS bonds are not introduced to the market until 1997, the outstanding bonds and choices of term to maturities are much more limited than ordinary treasury securities. This might lead to a little illiquidity of TIPS bonds as mentioned earlier. Second, the trading volume of TIPS bonds is relatively small

compared to other treasury securities because of its tax method. For T-Notes, unrealized interest income is not taxed until the bond is sold or it matures. On the contrary, TIPS principal adjustment will be taxed on a yearly basis no matter whether bond holders realized their gain or not. Over a 10 year horizon, compounding effect will substantially reduced investors' capital gain. As noted in the Princeton study, when inflation is very high, investors are not really sheltered from the inflation risk as they should have been. This tax policy also brings a lot of inconvenience for investor's tax preparation. Investors are hence less enthusiastic than they could have been about TIPS. However, TIPS fund has made TIPS more popular and the trading volume of TIPS has been increasing in the last two years.[24] Third, this study only covers the most recent interest increase period, not a whole business cycle. Fourth, since the major rating agencies downgraded GM and Ford's corporate bonds to junk status in May 2005, a lot of investors become more cautious in corporate bonds and invest more in treasury securities. The price of treasury bonds is bided up and the yield rate is hence pushed down. We noted that treasury yield rates have been decreasing while the Fed kept increasing the federal funds rate. This abnormal response of bond market to the interest raise may indicate that overall people expect long term inflation to be low and the economy is slowing down. However, since we only included twenty observations in May 2005, we believe the impact of corporate bond rating changes is limited.

The study obtained the following econometric model:

$$Pi = 0.305701 + 0.889478*Pi\_previous + -0.0167*Term\_spread^8 \qquad (3.3)$$

The coefficient of previous days is 0.889. This indicates a strong positive relationship between expected inflation and previous day's inflation expectation. This result is

---

[8] Term spread is 10 year treasury yield minus 1-month treasury yield.

consistent with our hypothesis that investors make their decisions on previous market's performance. We also argue that this is a dominant factor since there is not a consistent relationship between Fed's statement and inflation expectation. What is more, the coefficient of Term spread is only -0.0167, which seems to have only limited impact on inflation expectation.

Compared to the Princeton study, the coefficient of previous days' inflation expectation is very similar. The corresponding coefficient in that study is 0.87898. We also noted that in both studies, the significance level of previous days' inflation expectation is far higher than other components in the model. For instance, in our study the p-value of previous days' inflation expectation is $1.15*E-85$, while the p-value of intercept is only $3.24*E-4$. In the Princeton study the corresponding p-values are $6.40*E-101$ and $9.54*E-6$, respectively. This also demonstrates previous day's inflation expectation in the most important factor in investors' decision making process. On the other hand, in the Princeton study, the term spread[9] has a *positive* coefficient of 0.13 and p-value of $5.35*E-6$. We believe is due to the fact that the Princeton study also included exchange rate and oil price in the model. These three factors are somewhat correlated and they together explain more variation of inflation expectation.[10] The author hence argued that a smaller term spread indicates a looser monetary policy and that it will positively affect inflation expectation. Because of the lack of monetary policy tightening or loosing in their study, we do not agree with this proposition. Therefore, using term spread to quantify monetary policy change may not be the best way.

---

[9] The Princeton study used 10 year treasury yield minus 3-month treasury yield.
[10] In the Princeton study, the adjusted R square is 0.989.

In addition, we do not have evidence that is beyond reasonable doubt to prove there is a relationship between Fed statement and market inflation expectation. This may be surprising at a first look. However, when the Fed gave its first interest increase in three years, it symbolizes a reverse in its monetary policy. It shifted the whole market's focus from deflation risk to inflation risk. Hence we would argue that the first move to tighten monetary policy has the greatest psychological impact. Every subsequent Fed meeting minutes, public statement, and congress testimony are closely followed. Various consulting firms and investment banks' economists gather miscellaneous information such macroeconomic indicators from media and government to offer their advice. Investors then make their judgment and often take actions before increase. Therefore, successive increases are often anticipated by institutional investors. For instance, comments such as "The Fed will have a meeting today and it is generally expected to increase the federal funds rate by 0.25%" appear almost every time on the meeting day's newspapers. Likewise, in Fed's meeting minutes of Dec.14, 2004, the board of governors noted:

> *The FOMC decision in November to raise the intended federal funds*
>
> *rate 25 basis points and its attendant public statement were apparently*
>
> *anticipated by the market, so that the reaction was muted.*[25]

In other words, there is often little surprise before the Fed's consecutive increases. Indeed, on Jun.30, 2004, when the Fed brought first increase in three years, the inflation expectation jumped 2.97% from the previous day. It was the highest one-day inflation expectation increase in the period from May 3, 2004 to Aug.18 2004.[11] Subsequently, while FOMC meeting minutes release do sometimes cause significant increase of

---

[11] For complete data, please Appendix 1.

inflation expectation, the variation of inflation expectation on the day that Fed announced increase was quite moderate. On the other hand, during every two increases, we can always see substantial increase or decrease in market expectation. We believe these variations are caused by other factors such as fluctuation in various financial markets. Indeed, the Fed seriously considers market responses when making its decisions. As mentioned earlier, we will discuss the interaction between diverse financial markets and inflation expectation in the next chapter.

In conclusion, the study discovered that investors base their decisions primarily on previous day's market performance. Compared to this relationship, the impact of Fed's consecutive interest increase is relatively limited.

Chapter 4 the Impact of Inflation Expectation

In the last chapter, we analyzed major current concerns of inflation. We also discussed measures of inflation expectation and provided an econometric model for it. We argue that inflation expectation has substantial impacts on various financial markets and financial markets respond strongly to these impacts. We will explore this interaction in this chapter.

4.1. Inflation: the center of expectation

In various expectations people form for financial markets, the inflation expectation lies in the center. All other expectations are either partially determined by or represented by the inflation expectation. We will begin our analysis from a macroeconomic perspective.

Traditional Keynesian economics uses the IS-LM model to describe the general economy. Although the model has been criticized since it was invented, it is still generally accepted and widely used in college economics course. In an IS-LM model, the economy is divided in to the real side and the money side. A very important assumption of the IS-LM Model is that price level is stable in the short-run. This is because it takes time for all business sectors to realize that the general money supply has increased and to adjust their prices accordingly. Traditionally, it is regarded that the IS-LM model is not appropriate for analyzing inflation[26], since the price level is fixed in the IS-LM model. However, as discussed in the last chapter, people tend to use potential interest rate change

to guess future inflation. Hence this model is of crucial importance in analyzing *inflation expectation*. We will come back to this point later.

The IS curve represents the real side and describes the correlation between investment and saving. Let's begin with the general equation of GDP:

$$Y=C+I+G+X-M, \tag{4.1}$$

where Y is the output, C is consumption, G is government spending and X-M is net export. To simplify out analysis, let's assume X-M=0. Hence the demand and supply of goods or capital should achieve equilibrium and equal C+G+I in the market. In the private sector,

$$C=Ca + b*Yd , \tag{4.2}$$

where Ca is the exogenous spending and Yd is disposable income. The coefficient b is called the marginal propensity to consume. In addition,

$$Yd=Y-T, \tag{4.3}$$

and

$$T=Ta+t*Y, \tag{4.4}$$

where Ta is the exogenous part of taxes T. Also G=Ga, that is government spending is exogenous in our system. Finally,

$$I=Ia+c*Y-d*I, \tag{4.5}$$

where Ia is the exogenous part of I. Solve for equilibrium, we obtain:

$$d*i=(c+b-1-t)*Y + Ca-b*Ta + Ia + Ga, \tag{4.6}$$

Since b+c+t must be less than 1(because each component is only a fraction of Y), the curve have a negative slope. Indeed, in the short-run, a higher interest rate will encourage people to save and discourage private spending, which in turn discourage output. With

fewer orders in the pipeline and higher capital cost, business will be reluctant to borrow which make investment difficult. This may in turn decrease Y and cause potential recession. It is worth noting that although government spending is exogenous in our model, it plays an important role. As mentioned in 3.1, a higher government spending means less private spending and investment and gives upward pressure to interest rate.

The LM curve represents the money side and describes the correlation between money supply and demand. Here we have

$$Ms/P=L(Y,i), \tag{4.7}$$

where Ms is the supply of money, P is the price level, L is the demand of money and i is the interest rate. Let

$$L=e*y-f*I, \tag{4.8}$$

because higher output lead to higher demand for currency and higher interest lead to lower demand of money. Assume P=1 we have

$$f*i=e*Y-Ms. \tag{4.9}$$

Hence interest rate is positively correlated with output in the money market.

It is the interest rate that connects the two sides of economy. When economy is growing too fast and the inflation pressure is accelerating, the Fed will step forward and raise interest rate. This will effectively discourage spending in a credit based society like the U.S. and contract the economy. For instance, when interest rate are higher, household will be reluctant to purchase durable good such as house or car, for which people often need some credit. On the other hand, during a recession, the Fed will decrease interest through its open market operation and stimulate consumption, which through a chain of reactions expand the economy. We can see from the above that the general economy

cycles during this process. Historically, there is always a series of increases after decreases and vice versa.

Almost every time the Fed raises interest rate, their justification is to keep inflation pressure "well contained". The business world follows Fed's interpretation of macroeconomic factors closely, not only because their views are from brilliant professional economists, but also because their view indicate their potential action. A subtle change in the Fed's rhetoric as demonstrated in 3.1 will often lead their anticipation of an interest rate change. Since the interest rate level is crucial for firms' capital budgeting, the business world constantly keeps its eye on the Fed's every statement to gauge the inflation pressure. Investors will certainly be unhappy with a higher interest environment, which will then cause a chain of reactions in the financial market. Compared to firm specific news, news on inflation has far more impact on the general market because every firm is subject to overall economic environment change and their aggregate is the whole market. Therefore, inflation expectation is by far the most important expectation.

For instance, people often look at oil price and try to find the correlation between oil price and stock performance, but as we can see the correlation is sometimes positive and sometimes negative. We believe that oil price partially affects inflation expectation, which in turn affects market performance with other factors.

Furthermore, within a quarter (which is often considered short-run), only inflation expectation is available. Compare to corporate quarter earning reports, macroeconomic indicators such as weekly unemployment, monthly CPI are far more available. Hence analysts often look at these indicators and form their expectation of inflation.

We have an interesting paradox here. Investors tend to look at most recent news or data to from expectations and act on these expectations, although in the long-run economy performs in a very different way. This is why more psychology often plays an important role in short-run market analysis. As discussed in Chapter 2, various biases appear in this process, we will come back to this in Chapter 5.

After examining various factors in the short-run, we believe that the concern of inflation lies in the center of all expectations and hence has the most important impact.

4.2. Responses from financial markets

It is a natural question to ask: how do various financial markets respond to these impacts? We will first analyze the response in terms of volatility and then qualitatively analyze each of the three financial markets: commodity, stock and foreign exchange. More detailed quantitative analyses follow in the next section.

As we analyzed in Chapter 2, investors make buy and sell decision based on various expectations they form. Since the inflation expectation lies in the center of a number of different expectations, it is by far a determining factor in the decision-making process. When inflation indicators change, people adjust their expectation accordingly and subsequently decide to buy or sell. For instance, various analysts blame the Fed for the increase market volatility this year. They attribute elevated variation to Fed's continual increase of interest rates. Hence it is certainly possible that financial markets will respond to inflation expectation as being more volatile.

As for the commodity market, we would expect oil price and gold price will be two most responsive prices. In general, when inflation expectation increases, commodity

price will increase because the same amount of currency unit can only buy less amount of a good now. In fact, the initial purpose of the commodity market is for business firms to hedge price risk and plan business budget ahead. More specifically, oil price and gold price are often considered benchmarks in the commodity market. Higher inflation expectation will make investors conscious of the paper money in hand. They will worry that their paper money will further depreciate and will be eager to convert their money to hard goods. This will push prices even higher. In a word, we expect the commodity market will respond positively to the inflation expectation.

The stock market is a little more complicated because companies often have more stories than commodities. The price of a company's stock subjects to more factors' impact. Hence stocks' response to inflation expectation may not be obvious if we focus on individual companies. Over the years, various market indices have been developed and have served as good representatives of the stock market. Among the earlier indices is the Dow Jones Industrial Average (DJIA) and it is still the most closely followed index today. Other indices such as Standard and Poor's 500 and Russell 2000 are also common used. All indices are formed by assigning different weights for its components and display the aggregate move of a certain part of the market. For instance the DIJA is composed of the 30 biggest companies in America and the Russell 2000 represents 2000 small companies in America. We expect most companies respond negatively to the inflation expectation because higher inflation generally means higher capital cost.

As for foreign exchange market, a higher domestic inflation expectation will make investors more inclined to sell dollar. Hence there will be a downward pressure on U.S. dollars. It is worth noting that the dollar price often moves oppositely with the gold,

since gold is often considered a hard currency. The relative value of dollar also depends on the supply and demand of other foreign currencies and prices of these currencies ultimately depend on inflation expectations outside the Unites States.

Given the data availability we will primarily analyze and compare the response in the stock market and commodity market in the next section.

4.3 Regression Models and Conclusions

We obtained daily Sweet Crude oil price, Dow Jones Industrial Average and S&P 500 Index from EODData[27] and Yahoo finance[28], respectively. We chose these three indicators to analyze the response from the financial markets because they are good representative for oil future and stock market. They are presented frequently during the day and as mentioned earlier and readily available from various media. Hence they are by far the most closely followed and most visible financial indicator.

I matched the data horizon with our 10 year inflation expectation percentage in Chapter 3. The source data are presented in Appendix 3. I conducted simple regression using each financial indicator as the Y variable and the inflation expectation as the X variable. The study will present and compare regression results for each of three indicators in this section.

Crude Sweet

Regression Statistics	
Multiple R	0.622390436
R Square	0.387369855
Adjusted R Square	0.385031572
Standard Error	4.191398757
Observations	264

ANOVA

	df	SS	MS	F	Significance F
Regression	1	2910.359977	2910.36	165.6642	1.04408E-29
Residual	262	4602.769768	17.56782		
Total	263	7513.129745			

	Coefficients	Standard Error	t Stat	P-value
Intercept	-9.310055884	4.361627931	-2.13454	0.033727
X Variable 1	23.30337305	1.810524529	12.87106	1.04E-29

Table 4.1 Regression result for Sweet Crude oil price

As we can see from Table 4.1, the study achieved encouraging results for the regression between Sweet Crude oil and the inflation expectation. The significance level of our model is 1.044E-29, which allows us to be more than 99% confident that there exists a correlation between Sweet Crude oil price and the inflation expectation. The R square for our model is 0.387, which means that inflation expectation can explain 38.7% of the variation of Sweet Crude oil price. Given the complexity of financial world and simplicity of our model, the R square is satisfying. The correlation we obtained is:

$$\text{Sweet Crude oil price} = 23.3 * \text{Inflation expectation} - 9.31 \tag{4.10}$$

The equation implies a positive correlation between the Sweet Crude oil price and the inflation expectation. This confirms our earlier analyses of contemporary concerns of

inflation in 3.1. The positive coefficient also corresponds to the proposition that investors follow inflation news closely to make decisions.

From the above result, it is evident that inflation expectation strongly interacts with the Sweet Crude oil price. More generally, since the Sweet Crude oil price to a large extent represents the oil future market, we believe that the oil market substantially interacts with inflation expectation. Media will certainly facilitate investors to respond to variations of inflation expectation trough the feedback process illustrated in Chapter 2.

DJIA

Regression Statistics	
Multiple R	0.530230945
R Square	0.281144855
Adjusted R Square	0.278401133
Standard Error	233.4144984
Observations	264

ANOVA

	df	SS	MS	F	Significance F
Regression	1	5582718.159	5582718	102.4684	1.52694E-20
Residual	262	14274369.95	54482.33		
Total	263	19857088.11			

	Coefficients	Standard Error	t Stat	P-value
Intercept	7888.912593	242.8943783	32.47878	7.54E-94
X Variable 1	1020.629894	100.8261679	10.12267	1.53E-20

Table 4.2 Regression result for Dow Jones Industrial Average

As for Dow Jones Industrial Average (DJIA), we also obtained encouraging results. The significance level is 1.53E-20, which means that we are more than 99% confident that our result is valid. Compared to the Sweet Crude oil price, the 0.281 R square is considerably lower. This can be justified by the fact that a public company is definitely far more complicated than the commodity oil. Composed of 30 biggest U.S. companies' stock prices, it is by far the most followed stock index. It is often considered

a representative of the general stock market because its components are widely held by individuals in America through pension funds or mutual funds. It is highly sensitive to any corporate, politic or economic news. Hence inflation expectation can only explain 28.1% of the variation of the DJIA index. In this regression we obtained the following correlation:

$$DJIA = 1020.63*Inflation\ expectation + 7888.91\ (4.11)$$

S&P 500

Regression Statistics	
Multiple R	0.781435276
R Square	0.610641091
Adjusted R Square	0.609154988
Standard Error	25.5518094
Observations	264

ANOVA

	df	SS	MS	F	Significance F
Regression	1	268275.1947	268275.2	410.901	1.3624E-55
Residual	262	171058.4805	652.895		
Total	263	439333.6752			

	Coefficients	Standard Error	T Stat	P-value
Intercept	1687.046881	26.58956879	63.4477	4.8E-161
X Variable 1	-223.7359087	11.03740788	-20.2707	1.36E-55

Table 4.3 Regression result for S&P 500

I also conducted similar regression for S&P 500 index. The significance of our model is 1.36E-55, which is the highest in three models. The R-square is surprisingly as high as 0.609, which means inflation expectation can explain 60.9% of the variation. In this regression we obtained the following equation:

$$\underline{S\&P\ 500} = -223.74*Inflation\ Expectation +1687.05, \qquad (4.12)$$

53

Compared with the DJIA Index, S&P 500 includes 500 major public companies in the U.S., which is more representative of the overall stock market. Accordingly, we have a much higher significance level for S&P 500, because there are far less factors that could affect the 500 companies together. Furthermore, as mentioned in 4.1, since inflation expectation lies in the center of various economy-wide expectations, it explains a lot more variations of the S&P 500.It worth noting that the coefficients of inflation expectation in the DJIA model and the S&P 500 model have different signs. We believe that the negative coefficient in the S&P 500 model should be taken more seriously. This is because, for the general business world represented by S&P 500, a high inflation level is not healthy. The DJIA coefficient probably suggests that large U.S. companies are more robust to a high interest rate level than smaller companies. On the other hand, there are definitely days that S&P 500 and DJIA index does not move together. In conclusion, we believe the stock market also interacts strongly with the inflation expectation.

While our findings are encouraging, there are several limitations in this study. First, the simple regression models we offer here are simplifications of the financial market. Second, the time frame of our analyses is from May 3, 2004 to May 20, 2005. During this period the inflation expectation has more variations because the constant increase of the interest rate. Using a data set of a different horizon may lead to different results.

In conclusion, the study finds that the financial markets do interact with the inflation expectation strongly. Through a feedback process, this interaction account for a major part of variations of financial markets.

Chapter 5 Implications and Future Possibilities

We have just finished our discussion of inflation expectation and financial markets. Where do we go from here? As we went through the feedback loop between News, Expectation and Markets, one thing repeatedly come to our mind: technology and its role in the feedback process. To fulfill the general goal of exploring the interaction between technology and society of an Interactive Qualifying Project, we will discuss the impact of technology 5.1. We will then raise questions for future study in 5.2 to complete this study.

5.1 Advance in technology and market efficiency.

Since the Efficient Market Hypothesis (EMH) was brought out, it has been widely debated and publicized. In a number of finance textbooks, the weak and semi-strong form of the EMH was supported. In simple form, the EMH states that all public available information and even inside information is already reflected in the market. Any pricing errors will cause only a temporary arbitrage position and the market is efficient enough to correct itself quickly. On the other hand, as we mentioned in 2.1, researches in behavioral finance have challenged the EMH during the past decade. As Burton Malkiel noted[29]:

> *Various economists including Lawrence Summers believe that efficient market theory doesn't work; psychology might play a role. Psychologists such as Daniel Kahneman believe that decisions are strongly affected by behavioral components.*

It is generally regarded that markets are less efficient in the short-run. However, advances in technology are changing the financial world. For instance, the number of trading and analyzing software multiplied during the past five years. Advance in computation technology and Internet made once professional and expensive tools widely available to ordinary investors. In addition, financial blogs, forums and educational websites have been increasingly popular. Non professional investors nowadays are no longer satisfied with TV analysts and newspaper columns. They aggressively seek information through various online resources. Furthermore, online trading and other electronic trading tools allow people to respond instantly to any change in the market. Investors can even obtain quotes from and trade on cell phones. After hour trading further empowers investors to respond to changes in other parts of the world and domestic changes after the closing bell. We believe these advances in technology that former investors can never imagine greatly improved market efficiency.

A typical example of improved market efficiency is the disappearance of past trends. As Burton Malkiel noted:

If the pattern is true, it is likely to self destruct as profit-maximizing investors seek to exploit it. Indeed, the more predictable any return predictability appears to be, the less likely it is to survive.

...Any regularity in the stock market that can be discovered and acted upon is bound to destroy itself.[30]

We believe market will be more and more efficient as advance in behavioral finance research continues to reveal patterns of investors' decision process and technology help publicize them. This trend offers the following two implications.

First, don't take advertisement and news comments too seriously. Jackson Goss of Putnam Fund once said[31]: "We don't sell funds; we sell dreams, such as security and college educations, with mutual funds as the way to realize those dreams." Similarly, a lot of companies and brokers sell a story or a concept rather than the real value of the asset. In addition, most stock analysts attribute market movement to latest economic indicators, as we often watch on television. However, most indicators are lagged data and subject to substantial revisions. Second, don't get into short-term speculation unless one thinks one can beat sophisticated analysts. In his book, The Great Crash, John Galbraith observes[32], "Speculation on a large scale requires a persuasive sense of confidence and optimism and con conviction that ordinary people were meant to be rich." This implication goes back to our quote of Mark Twain in Chapter 1.

5.2 Future possibilities

Keynes said in his famous book *The General Theory* that "In the long run we are all dead." The debate between short-run and long-run behaviors of economics has never stopped. As this study found that people's short-run performance is affected by their long-run expectation, we wonder how we can differentiate short-run and long-run market. With the increasing popularity of low-cost index funds, we wonder if that will make market more efficient. In addition invest by index funds essentially distribute capital more equally. This seems to contradict financial markets' function of channeling money and allocate scarce resources optimally. With a curious mind, we end our study here, leaving a series of questions that inspire and challenge future researchers to answer.

Reference

1. The Nobel Foundation.
    http://nobelprize.org/economics/laureates/2002/. July, 2005.

2. Behavioral Finance
    http://history.behaviouralfinance.net/. July, 2005.

3. Richard H Thaler and Nicholas Barberis, *A Survey of Behavioral Finance.* Hand book
    of the Economics of Finance. Elsevier Science, 2003.

4. Alpert, M., and H. Raiffa (1982), *A progress report on the training of probability
    assessors*, in:
    > D. Kahneman, P. Slovic and A. Tversky, eds., Judgment Under Uncertainty:
    > Heuristics and Biases (Cambridge University Press, Cambridge) pp. 294–305.

5. Nightly Business Report, May 11, 2005.

6. Shiller, Robert J., (2005), *Irrational Exuberance,* p87, Princeton, N. J.: Princeton UP.

7. *Lasting Leadership*. Wharton School Publishing, 2004.

8. Nightly Business Report.

9. Shiller, Robert J., (2005), *Irrational Exuberance,* Princeton, N. J.: Princeton UP, 2005.

10. Shiller, Robert J., *Irrational Exuberance,* p78, Princeton, N. J.: Princeton UP 2005.

11. Hass, Albert, (1967), *Bulls, Bear and Dr. Freud.* The World Publishing Co.,
    Cleveland, OH.

12. Kahneman, Daniel and Amos Tversky, *Prospect Theory: An Analysis of Decision
    under Risk*, Econometrica, Volume 47, Issue 2 (Mar., 1979), 263-292

13. Michael Chuk, Joseph Nolan, David Seermon, Brandon Leach and Paul Leoncini,
    IQP0301, Stock Market Simulation.

14. Shiller, Robert J., *Irrational Exuberance,* p73, Princeton, N. J.: Princeton UP, 2005.

15. BROWNE, ANDREW *How a News Story, Translated Badly, Caused Trading Panic,*
    the Wall street Journal, May 12, 2005; Page A1.

16. Shiller, Robert J., (2005), *Irrational Exuberance,* Princeton, N. J.: Princeton UP

17. Michael Chuk, Joseph Nolan, David Seermon, Brandon Leach and Paul Leoncini,
    IQP0301, Stock Market Simulation

18. IP, GREG, *Greenspan Sees Oil Volatility Easing*, The Wall Street Journal.
April 6, 2005; Page A3

19. The Wall Street Journal. *Walking Season.* April 11, 2005; Page C1

20. BROWNING, E.S., *Fed's Inflation Redo Spurs Mini Rally* The Wall Street Journal
May 4, 2005; Page C1

21. Shiller, Robert J., (2005), *Irrational Exuberance,* Princeton, N. J.: Princeton UP.

22. The Princeton study.

23. The Princeton study.

24. TreasuryDirect, Jun.6, 2005.
http://www.treasurydirect.gov/indiv/products/tips_glance.htm

25. Minutes of FOMC meeting on Dec. 14, 2004 The Federal Reserve System.
http://www.federalreserve.gov/fomc/minutes/20041214.htm

26. Roubini, Nouriel and Backus, David, *Lectures in Macroeconomics*, Jul.10, 2005.
http://pages.stern.nyu.edu/~nroubini/NOTES/CHAP9.HTM

27. EODData, Jul.16, 2005. www.edodata.com.

28. Yahoo Finance. http://finance.yahoo.com/

29. Malkiel, Burton G., (2003), A *Random Walk down Wall Street,* p243. W. W. Norton
& Company, New York.

30. Malkiel, Burton G., (2003), A *Random Walk down Wall Street.* W. W. Norton &
Company, New York.

31. Malkiel, Burton G., (2003), A *Random Walk down Wall Street.* W. W. Norton &
Company, New York.

32. Malkiel, Burton G., (2003), A *Random Walk down Wall Street.* W. W. Norton &
Company, New York.

Appendix 1. Daily Yield Rates, Expected Inflation Rate and its Percent Change

(Data from U.S. Treasury are in bold; Fed rate increase days are in bold)

Date	10 yr TIPS	10 yr T-Notes	Pi_10 year	10 year Pi Daily Percent Change
5/3/2004	2.09%	4.53	2.167464	0.182908
5/4/2004	2.10%	4.56	2.171429	1.096491
5/5/2004	2.10%	4.61	2.195238	-1.90183
5/6/2004	2.15%	4.63	2.153488	-0.70098
5/7/2004	2.24%	4.79	2.138393	-0.02876
5/10/2004	2.25%	4.81	2.137778	1.386629
5/11/2004	2.21%	4.79	2.167421	2.693784
5/12/2004	2.17%	4.83	2.225806	-0.04654
5/13/2004	2.18%	4.85	2.224771	-0.32264
5/14/2004	2.16%	4.79	2.217593	2.38722
5/17/2004	2.07%	4.7	2.270531	1.834977
5/18/2004	2.05%	4.74	2.312195	2.050467
5/19/2004	2.03%	4.79	2.359606	2.057859
5/20/2004	1.96%	4.72	2.408163	-3.10734
5/21/2004	2.04%	4.76	2.333333	1.279318
5/24/2004	2.01%	4.75	2.363184	-1.40213
5/25/2004	2.03%	4.73	2.330049	0.716054
5/26/2004	1.99%	4.67	2.346734	-0.49892
5/27/2004	1.97%	4.6	2.335025	-0.21522
5/28/2004	2.00%	4.66	2.33	2.612144
6/1/2004	1.97%	4.71	2.390863	-2.81629
6/2/2004	2.04%	4.74	2.323529	-1.11763
6/3/2004	2.05%	4.71	2.297561	-1.39966
6/4/2004	2.11%	4.78	2.265403	0
6/7/2004	2.11%	4.78	2.265403	-1.86047
6/8/2004	2.15%	4.78	2.223256	-1.45493
6/9/2004	2.20%	4.82	2.190909	0.708059
6/10/2004	2.18%	4.81	2.206422	-1.9355
6/14/2004	2.26%	4.89	2.163717	0.350299
6/15/2004	2.16%	4.69	2.171296	0.138886
6/16/2004	2.18%	4.74	2.174312	0.287154
6/17/2004	2.16%	4.71	2.180556	0.678418
6/18/2004	2.15%	4.72	2.195349	-0.88473
6/21/2004	2.16%	4.7	2.175926	-0.03726
6/22/2004	2.17%	4.72	2.175115	-0.66961
6/23/2004	2.18%	4.71	2.16055	0.318965
6/24/2004	2.15%	4.66	2.167442	-0.46296
6/25/2004	2.16%	4.66	2.157407	-1.06045
6/28/2004	2.23%	4.76	2.134529	0.085943
6/29/2004	2.20%	4.7	2.136364	2.978723
6/30/2004	2.10%	4.62	2.2	1.827094
7/1/2004	2.04%	4.57	2.240196	2.031885
Date	10 yr TIPS	10 yr T-Notes	Pi_10 year	10 year Pi Daily Percent Change

Date	10 yr TIPS	10 yr T-Notes	Pi_10 year	10 year Pi Daily Percent Change
7/6/2004	1.97%	4.49	2.279188	-1.28062
7/7/2004	2.00%	4.5	2.25	-1.21012
7/8/2004	2.02%	4.49	2.222772	0
7/9/2004	2.02%	4.49	2.222772	-0.66815
7/12/2004	2.02%	4.46	2.207921	0.399832
7/13/2004	2.03%	4.5	2.216749	0.49505
7/14/2004	2.02%	4.5	2.227723	0.497512
7/15/2004	2.01%	4.5	2.238806	0.845361
7/16/2004	1.94%	4.38	2.257732	-1.02041
7/19/2004	1.96%	4.38	2.234694	-2.42566
7/20/2004	2.05%	4.47	2.180488	0.671141
7/21/2004	2.05%	4.5	2.195122	0.536398
7/22/2004	2.03%	4.48	2.206897	0.820312
7/23/2004	2.00%	4.45	2.225	-1.56207
7/26/2004	2.05%	4.49	2.190244	-1.89051
7/27/2004	2.15%	4.62	2.148837	1.675181
7/28/2004	2.11%	4.61	2.184834	1.711256
7/29/2004	2.07%	4.6	2.222222	0.746269
7/30/2004	2.01%	4.5	2.238806	0.053333
8/2/2004	2.00%	4.48	2.24	0.333694
8/3/2004	1.98%	4.45	2.247475	-1
8/4/2004	2.00%	4.45	2.225	1.582206
8/5/2004	1.96%	4.43	2.260204	3.07345
8/6/2004	1.82%	4.24	2.32967	-0.69352
8/9/2004	1.85%	4.28	2.313514	-1.72159
8/10/2004	1.90%	4.32	2.273684	1.677618
8/11/2004	1.86%	4.3	2.311828	2.045484
8/12/2004	1.81%	4.27	2.359116	1.062464
8/13/2004	1.77%	4.22	2.384181	-1.82543
8/16/2004	1.82%	4.26	2.340659	-1.17371
8/17/2004	1.82%	4.21	2.313187	-0.07398
8/18/2004	1.83%	4.23	2.311475	3.731464
8/19/2004	1.76%	4.22	2.397727	-1.20999
8/20/2004	1.79%	4.24	2.368715	-2.85555
8/23/2004	1.86%	4.28	2.301075	-0.53476
8/24/2004	1.87%	4.28	2.28877	-0.99672
8/25/2004	1.88%	4.26	2.265957	0.126205
8/26/2004	1.86%	4.22	2.268817	0.236967
8/27/2004	1.86%	4.23	2.274194	0.678216
8/30/2004	1.83%	4.19	2.289617	1.336784
8/31/2004	1.78%	4.13	2.320225	0.564972
9/1/2004	1.77%	4.13	2.333333	-1.63934
9/2/2004	1.83%	4.2	2.295082	-0.34195
9/3/2004	1.88%	4.3	2.287234	0.135034
9/7/2004	1.86%	4.26	2.290323	0.278595
9/8/2004	1.82%	4.18	2.296703	0.405261
9/9/2004	1.83%	4.22	2.306011	-0.7109
9/10/2004	1.83%	4.19	2.289617	0.38107

Date	10 yr TIPS	10 yr T-Notes	Pi_10 year	10 year Pi Daily Percent Change
9/14/2004	1.81%	4.15	2.292818	-1.98471
9/15/2004	1.86%	4.18	2.247312	0.304
9/16/2004	1.81%	4.08	2.254144	-0.72337
9/17/2004	1.85%	4.14	2.237838	1.039989
9/20/2004	1.80%	4.07	2.261111	-0.4914
9/21/2004	1.80%	4.05	2.25	2.761721
9/22/2004	1.73%	4	2.312139	-1.21307
9/23/2004	1.76%	4.02	2.284091	-0.63167
9/24/2004	1.78%	4.04	2.269663	2.719894
9/27/2004	1.72%	4.01	2.331395	1.428781
9/28/2004	1.70%	4.02	2.364706	-1.48688
9/29/2004	1.76%	4.1	2.329545	0.405126
9/30/2004	1.77%	4.14	2.338983	-1.6433
10/1/2004	1.83%	4.21	2.300546	-2.0803
10/4/2004	1.86%	4.19	2.252688	0.845699
10/5/2004	1.84%	4.18	2.271739	-1.9995
10/6/2004	1.90%	4.23	2.226316	1.242073
10/7/2004	1.89%	4.26	2.253968	3.438044
10/8/2004	1.78%	4.15	2.331461	0.979002
10/12/2004	1.75%	4.12	2.354286	1.00333
10/13/2004	1.72%	4.09	2.377907	0.879031
10/14/2004	1.68%	4.03	2.39881	-0.19559
10/15/2004	1.70%	4.07	2.394118	-0.5848
10/18/2004	1.71%	4.07	2.380117	0.588235
10/19/2004	1.70%	4.07	2.394118	0.899914
10/20/2004	1.66%	4.01	2.415663	2.469136
10/21/2004	1.62%	4.01	2.475309	-1.46585
10/22/2004	1.64%	4	2.439024	0.361963
10/25/2004	1.63%	3.99	2.447853	0.501253
10/26/2004	1.63%	4.01	2.460123	-3.43073
10/27/2004	1.73%	4.11	2.375723	2.47509
10/28/2004	1.68%	4.09	2.434524	2.05949
10/29/2004	1.63%	4.05	2.484663	-0.94921
11/1/2004	1.67%	4.11	2.461078	3.474332
11/2/2004	1.61%	4.1	2.546584	-0.2439
11/3/2004	1.61%	4.09	2.540373	-2.18567
11/4/2004	1.65%	4.1	2.484848	-0.91998
11/5/2004	1.71%	4.21	2.461988	-0.34525
11/8/2004	1.72%	4.22	2.453488	-1.14943
11/9/2004	1.74%	4.22	2.425287	0.13541
11/10/2004	1.75%	4.25	2.428571	1.135191
11/12/2004	1.71%	4.2	2.45614	2.39521
11/15/2004	1.67%	4.2	2.51497	-0.35856
11/16/2004	1.68%	4.21	2.505952	1.353774
11/17/2004	1.63%	4.14	2.539877	-1.0899
11/18/2004	1.64%	4.12	2.512195	0.110459
11/19/2004	1.67%	4.2	2.51497	2.595532
11/22/2004	1.62%	4.18	2.580247	-1.5833

Date	10 yr TIPS	10 yr T-Notes	Pi_10 year	10 year Pi Daily Percent Change
11/24/2004	1.64%	4.2	2.560976	-0.26391
11/26/2004	1.66%	4.24	2.554217	-2.34765
11/29/2004	1.74%	4.34	2.494253	-0.11323
11/30/2004	1.75%	4.36	2.491429	-1.78617
12/1/2004	1.79%	4.38	2.446927	-1.73915
12/2/2004	1.83%	4.4	2.404372	2.655018
12/3/2004	1.73%	4.27	2.468208	1.049731
12/6/2004	1.70%	4.24	2.494118	0.354471
12/7/2004	1.69%	4.23	2.502959	2.101392
12/8/2004	1.62%	4.14	2.555556	-0.02651
12/9/2004	1.64%	4.19	2.554878	-1.91218
12/10/2004	1.66%	4.16	2.506024	0.606061
12/13/2004	1.65%	4.16	2.521212	1.362179
12/14/2004	1.62%	4.14	2.555556	1.938521
12/15/2004	1.57%	4.09	2.605096	-1.92766
12/16/2004	1.64%	4.19	2.554878	0.477327
12/17/2004	1.64%	4.21	2.567073	1.234568
12/20/2004	1.62%	4.21	2.598765	1.160758
12/21/2004	1.59%	4.18	2.628931	-1.7539
12/22/2004	1.63%	4.21	2.582822	1.095276
12/23/2004	1.62%	4.23	2.611111	-1.38871
12/27/2004	1.67%	4.3	2.57485	-0.95363
12/28/2004	1.69%	4.31	2.550296	-1.85883
12/29/2004	1.73%	4.33	2.50289	0.354571
12/30/2004	1.70%	4.27	2.511765	0.479536
12/31/2004	1.68%	4.24	2.52381	-1.40954
1/3/2005	1.70%	4.23	2.488235	-3.13969
1/4/2005	1.78%	4.29	2.410112	-0.55866
1/5/2005	1.79%	4.29	2.396648	1.704545
1/6/2005	1.76%	4.29	2.4375	-2.22222
1/7/2005	1.80%	4.29	2.383333	1.694915
1/10/2005	1.77%	4.29	2.423729	-0.13509
1/11/2005	1.76%	4.26	2.420455	1.495292
1/12/2005	1.73%	4.25	2.456647	0.567474
1/13/2005	1.70%	4.2	2.470588	-0.45681
1/14/2005	1.72%	4.23	2.459302	0.109217
1/18/2005	1.71%	4.21	2.461988	0.349308
1/19/2005	1.70%	4.2	2.470588	-0.71429
1/20/2005	1.70%	4.17	2.452941	0.350489
1/21/2005	1.69%	4.16	2.461538	0.111607
1/24/2005	1.68%	4.14	2.464286	-2.04898
1/25/2005	1.74%	4.2	2.413793	1.403654
1/26/2005	1.72%	4.21	2.447674	0.23753
1/27/2005	1.72%	4.22	2.453488	2.760304
1/28/2005	1.65%	4.16	2.521212	-0.48077
1/31/2005	1.65%	4.14	2.509091	-0.95895
2/1/2005	1.67%	4.15	2.48503	-1.76471
2/2/2005	1.70%	4.15	2.441176	-1.02375

Date	10 yr TIPS	10 yr T-Notes	Pi_10 year	10 year Pi Daily Percent Change
2/4/2005	1.65%	4.09	2.478788	1.353799
2/7/2005	1.62%	4.07	2.512346	2.677663
2/8/2005	1.57%	4.05	2.579618	4.068274
2/9/2005	1.49%	4	2.684564	-3.43471
2/10/2005	1.57%	4.07	2.592357	0.737101
2/11/2005	1.57%	4.1	2.611465	1.450744
2/14/2005	1.54%	4.08	2.649351	-3.87894
2/15/2005	1.61%	4.1	2.546584	-0.9963
2/16/2005	1.65%	4.16	2.521212	0.721154
2/17/2005	1.65%	4.19	2.539394	0.688837
2/18/2005	1.67%	4.27	2.556886	0.468384
2/22/2005	1.67%	4.29	2.568862	1.35454
2/23/2005	1.64%	4.27	2.603659	-0.14052
2/24/2005	1.65%	4.29	2.6	0.140713
2/25/2005	1.64%	4.27	2.603659	-1.49607
2/28/2005	1.70%	4.36	2.564706	1.053146
3/1/2005	1.69%	4.38	2.591716	0
3/2/2005	1.69%	4.38	2.591716	0.228311
3/3/2005	1.69%	4.39	2.597633	0.791054
3/4/2005	1.65%	4.32	2.618182	0.992672
3/7/2005	1.63%	4.31	2.644172	-0.80998
3/8/2005	1.67%	4.38	2.622754	-2.63396
3/9/2005	1.77%	4.52	2.553672	-0.3218
3/10/2005	1.76%	4.48	2.545455	-1.56986
3/11/2005	1.82%	4.56	2.505495	-0.87719
3/14/2005	1.82%	4.52	2.483516	0.442478
3/15/2005	1.82%	4.54	2.494505	1.228066
3/16/2005	1.79%	4.52	2.52514	2.323648
3/17/2005	1.73%	4.47	2.583815	-1.38526
3/18/2005	1.77%	4.51	2.548023	-1.2306
3/21/2005	1.80%	4.53	2.516667	-1.61844
3/22/2005	1.87%	4.63	2.475936	-3.02488
3/23/2005	1.92%	4.61	2.401042	0.833428
3/24/2005	1.90%	4.6	2.421053	-1.21022
3/28/2005	1.94%	4.64	2.391753	0.695071
3/29/2005	1.91%	4.6	2.408377	0.179434
3/30/2005	1.89%	4.56	2.412698	4.197295
3/31/2005	1.79%	4.5	2.513966	0.231011
4/1/2005	1.77%	4.46	2.519774	-0.89561
4/4/2005	1.79%	4.47	2.497207	-0.88373
4/5/2005	1.81%	4.48	2.475138	-0.34226
4/6/2005	1.80%	4.44	2.466667	-1.60701
4/7/2005	1.85%	4.49	2.427027	0.767406
4/8/2005	1.84%	4.5	2.445652	-0.02442
4/11/2005	1.82%	4.45	2.445055	3.547444
4/12/2005	1.73%	4.38	2.531792	-0.57471
4/13/2005	1.74%	4.38	2.517241	0.931825
4/14/2005	1.72%	4.37	2.540698	0.63717

4/18/2005	1.66%	4.27	2.572289	1.029288
4/19/2005	1.62%	4.21	2.598765	1.490499
4/20/2005	1.60%	4.22	2.6375	-1.33044
4/21/2005	1.66%	4.32	2.60241	1.673568
4/22/2005	1.61%	4.26	2.645963	-1.22699
4/25/2005	1.63%	4.26	2.613497	-1.34623
4/26/2005	1.66%	4.28	2.578313	-0.09912
4/27/2005	1.65%	4.25	2.575758	2.956069
4/28/2005	1.58%	4.19	2.651899	-1.39492
4/29/2005	1.61%	4.21	2.614907	0
5/2/2005	1.61%	4.21	2.614907	-1.82927
5/3/2005	1.64%	4.21	2.567073	0.37451
5/4/2005	1.63%	4.2	2.576687	0.377719
5/5/2005	1.62%	4.19	2.58642	-2.08301
5/6/2005	1.69%	4.28	2.532544	0.233645
5/9/2005	1.69%	4.29	2.538462	0.991736
5/10/2005	1.65%	4.23	2.563636	0.13406
5/11/2005	1.64%	4.21	2.567073	-1.90882
5/12/2005	1.66%	4.18	2.518072	-1.43541
5/13/2005	1.66%	4.12	2.481928	0.242718
5/16/2005	1.66%	4.13	2.487952	0.974429
5/17/2005	1.64%	4.12	2.512195	-1.8123
5/18/2005	1.65%	4.07	2.466667	-1.40732
5/19/2005	1.69%	4.11	2.431953	1.690051
5/20/2005	1.67%	4.13	2.473054	

Appendix 2. Selected news on days with dramatic changes

Date	News	Change	Source
05/21/2004	"U.S. stocks headed higher at Friday's open as tame inflation comments from a Federal Reserve official helped lower bond yields and crude prices, and lift investor spirits."	-3.107344	AFX News Limited
10/8/2004	"Federal Reserve Governor Ben Bernanke is speaking up again, and it may not be a coincidence that oil prices also keep rising. Mr. Bernanke suggested yesterday that softer economic growth could trigger a pause in the Fed's determination to end its easy money policy. Commodities like oil are the canary in the coal mine of future inflation. Oil in particular has an inelastic supply curve, as economists put it, meaning that as demand surges in a growing world economy, the price tends to surge with it."	3.438043994	The Wall Street Journal
10/27/2004	The main US equity indices were lower in early trade on Wednesday as the onslaught of quarterly earnings continued while the oil price hovered around the $ 55 per barrel mark and economic data **disappointed** expectations.	-3.43072954	AFX News Limited
1/4/2005	The FOMC was roughly split into two camps on the outlook for inflation at their closed-door meeting on Dec. 14. Although the faction that insists that inflation is under control won out at the December meeting, the minutes showed a number of the U.S. central bankers on the committee were growing worried that the weaker dollar, higher energy	-3.13969241	AFX News Limited

1/4/2005	prices and a slowdown in productivity growth could lead to higher prices.	-3.13969241	AFX News Limited
2/10/2005	The U.S. economy is on a solid growth path with no sign of an uptick in inflation, said Gary Stern, the president of the Federal Reserve Bank of Minneapolis. "I just don't see the signs - the ingredients- that would perhaps contribute to higher inflation. "There may be a few things around the edges that are worth worrying about if you really want to, but the preponderance of evidence suggests that inflation is going to stay modest," Stern said.	-3.43471338	AFX News Limited
3/31/2005	The bond market has been especially nervous about accelerated inflation since the Federal Reserve made hawkish comments on the subject last week. Inflation erodes the value of fixed-income instruments. The core deflator's year-over-year rate of increase remained steady at 1.6 percent. However, the rate of increase in the months of December, January and February now equates to 1.8 percent, which in fact would show acceleration, according to Ian Shepherdson, Chief U.S. Economist at High Frequency Economics.	4.197294913	AFX News Limited
4/12/2005	Many members said that circumstances had changed dramatically from their previous meeting in late January, with signs of a stronger economy than previously perceived and risks that inflation pressures could be intensifying. 'While underlying inflation appeared to have moved up only modestly, and nearly all participants thought that core and total inflation going forward would	3.547444307	AFX News Limited

4/12/2005	be relatively low, they had become less certain of that outlook for the next few quarters,' according to the minutes.	3.547444307	AFX News Limited

Appendix 3. Daily Sweet Oil Price, S&P 500 and Dow Jones Industrial Average

Index

(Data from EODData are in bold)

Date	Dow Adj.	S&P Adj	Sweet	Pi_10 year
5/3/2004	10314	1189.28	38.21	
5/4/2004	10317.2	1191.08	38.98	2.167464
5/5/2004	10310.95	1185.56	39.57	2.171429
5/6/2004	10241.26	1173.8	39.37	2.195238
5/7/2004	10117.34	1165.69	39.93	2.153488
5/10/2004	9990.02	1154.05	38.93	2.138393
5/11/2004	10019.47	1159.36	40.06	2.137778
5/12/2004	10045.16	1171.11	40.77	2.167421
5/13/2004	10010.74	1166.22	41.08	2.225806
5/14/2004	10012.87	1178.84	41.38	2.224771
5/17/2004	9906.91	1171.35	41.55	2.217593
5/18/2004	9968.51	1172.63	40.42	2.270531
5/19/2004	9937.71	1175.65	41.52	2.312195
5/20/2004	9937.64	1161.17	40.8	2.359606
5/21/2004	9966.74	1162.16	39.93	2.408163
5/24/2004	9958.43	1156.85	41.72	2.333333
5/25/2004	10117.62	1143.22	41.14	2.363184
5/26/2004	10109.89	1156.38	40.7	2.330049
5/27/2004	10205.2	1151.83	39.44	2.346734
5/28/2004	10188.45	1162.1	39.88	2.335025
6/1/2004	10202.65	1152.12	42.33	2.33
6/2/2004	10262.97	1159.95	39.96	2.390863
6/3/2004	10195.91	1137.5	39.28	2.323529
6/4/2004	10242.82	1152.78	38.49	2.297561
6/7/2004	10391.08	1145.98	38.66	2.265403
6/8/2004	10432.52	1142.62	37.28	2.265403
6/9/2004	10368.44	1162.05	37.54	2.223256
6/10/2004	10410.1	1173.79	38.45	2.190909
6/14/2004	10334.73	1187.76	37.88	2.206422
6/15/2004	10380.43	1181.21	37.42	2.163717
6/16/2004	10379.58	1181.2	37.65	2.171296
6/17/2004	10377.52	1191.14	38.81	2.174312
6/18/2004	10416.41	1184.07	39	2.180556
6/21/2004	10371.47	1181.39	37.77	2.195349
6/22/2004	10395.07	1176.12	38.25	2.175926
6/23/2004	10479.57	1172.92	37.57	2.175115
6/24/2004	10443.81	1180.59	37.93	2.16055
6/25/2004	10371.84	1181.41	37.55	2.167442
6/28/2004	10357.09	1165.36	36.24	2.157407
6/29/2004	10413.43	1174.28	35.66	2.134529
6/30/2004	10435.48	1171.42	37.05	2.136364
7/1/2004	10334.16	1172.53	38.74	2.2

7/2/2004	10282.83	1171.71	38.39	2.240196
7/6/2004	10219.34	1183.78	39.65	2.285714
7/7/2004	10240.29	1189.65	39.08	2.279188
7/8/2004	10171.56	1190.21	40.33	2.25
7/9/2004	10213.22	1188.07	39.96	2.222772
7/12/2004	10238.22	1197.75	39.5	2.222772
7/13/2004	10247.59	1206.83	39.44	2.207921
7/14/2004	10208.8	1200.08	40.97	2.216749
7/15/2004	10163.16	1209.25	40.77	2.227723
7/16/2004	10139.78	1207.01	41.25	2.238806
7/19/2004	10094.06	1219.43	41.44	2.257732
7/20/2004	10149.07	1225.31	40.44	2.234694
7/21/2004	10046.13	1222.12	40.58	2.180488
7/22/2004	10050.33	1210.47	41.36	2.195122
7/23/2004	9962.22	1210.08	41.71	2.206897
7/26/2004	9961.92	1210.41	41.44	2.225
7/27/2004	10085.14	1203.6	41.84	2.190244
7/28/2004	10117.07	1211.37	42.9	2.148837
7/29/2004	10129.24	1200.2	42.75	2.184834
7/30/2004	10139.71	1190.8	43.8	2.222222
8/2/2004	10179.16	1184.16	43.82	2.238806
8/3/2004	10120.24	1201.59	44.15	2.24
8/4/2004	10126.51	1200.75	42.83	2.247475
8/5/2004	9963.03	1210.34	44.41	2.225
8/6/2004	9815.33	1210.12	43.95	2.260204
8/9/2004	9814.66	1206.14	44.84	2.32967
8/10/2004	9944.67	1205.3	44.52	2.313514
8/11/2004	9938.32	1197.01	44.8	2.273684
8/12/2004	9814.59	1191.99	45.5	2.311828
8/13/2004	9825.35	1202.3	46.58	2.359116
8/16/2004	9954.55	1201.72	46.05	2.384181
8/17/2004	9972.83	1203.03	46.75	2.340659
8/18/2004	10083.15	1189.89	47.27	2.313187
8/19/2004	10040.82	1193.19	48.7	2.311475
8/20/2004	10110.14	1189.41	46.72	2.397727
8/23/2004	10073.05	1181.27	46.05	2.368715
8/24/2004	10098.63	1171.36	45.21	2.301075
8/25/2004	10181.74	1174.55	43.47	2.28877
8/26/2004	10173.41	1174.07	43.1	2.265957
8/27/2004	10195.01	1168.41	43.18	2.268817
8/30/2004	10122.52	1163.75	42.28	2.274194
8/31/2004	10173.92	1167.87	42.12	2.289617
9/1/2004	10168.46	1175.41	44	2.320225
9/2/2004	10290.28	1184.63	44.06	2.333333
9/3/2004	10260.2	1195.98	43.99	2.295082
9/7/2004	10341.16	1184.52	43.31	2.287234
9/8/2004	10313.36	1177.45	42.77	2.290323
9/9/2004	10289.1	1187.7	44.61	2.296703
9/10/2004	10313.07	1182.99	42.81	2.306011
9/13/2004	10314.76	1190.25	43.87	2.289617

9/14/2004	10318.16	1186.19	44.39	2.298343
9/15/2004	10231.36	1187.89	43.58	2.292818
9/16/2004	10244.49	1183.74	43.88	2.247312
9/17/2004	10284.46	1188.05	45.59	2.254144
9/20/2004	10204.89	1202.08	46.35	2.237838
9/21/2004	10244.93	1211.92	46.76	2.261111
9/22/2004	10109.18	1213.55	48.35	2.25
9/23/2004	10038.9	1213.45	48.46	2.312139
9/24/2004	10047.24	1213.54	48.88	2.284091
9/27/2004	9988.54	1204.92	49.64	2.269663
9/28/2004	10077.4	1210.13	49.9	2.331395
9/29/2004	10136.24	1209.57	49.51	2.364706
9/30/2004	10080.27	1205.45	49.64	2.329545
10/1/2004	10192.65	1194.65	50.12	2.338983
10/4/2004	10216.54	1194.2	49.91	2.300546
10/5/2004	10177.68	1203.21	51.09	2.252688
10/6/2004	10239.92	1205.72	52.02	2.271739
10/7/2004	10125.4	1203.38	52.67	2.226316
10/8/2004	10055.2	1198.68	53.31	2.253968
10/11/2004	10081.97	1188	53.64	2.331461
10/12/2004	10077.18	1189.24	52.51	2.354286
10/13/2004	10002.33	1182.81	53.64	2.377907
10/14/2004	9894.45	1177.07	54.76	2.39881
10/15/2004	9933.38	1190.25	54.93	2.394118
10/18/2004	9956.32	1191.17	53.67	2.380117
10/19/2004	9897.62	1190.33	53.29	2.394118
10/20/2004	9886.93	1191.37	54.41	2.415663
10/21/2004	9865.76	1173.82	54.47	2.475309
10/22/2004	9757.81	1178.57	55.17	2.439024
10/25/2004	9749.99	1182.65	54.54	2.447853
10/26/2004	9888.48	1181.76	55.17	2.460123
10/27/2004	10002.03	1176.94	52.46	2.375723
10/28/2004	10004.54	1177.24	50.92	2.434524
10/29/2004	10027.47	1170.34	51.76	2.484663
11/1/2004	10054.39	1183.55	50.13	2.461078
11/2/2004	10035.73	1181.94	49.62	2.546584
11/3/2004	10137.05	1175.43	50.88	2.540373
11/4/2004	10314.76	1183.81	48.82	2.484848
11/5/2004	10387.54	1184.17	49.61	2.461988
11/8/2004	10391.31	1173.48	49.09	2.453488
11/9/2004	10386.37	1162.91	47.37	2.425287
11/10/2004	10385.48	1164.08	48.86	2.428571
11/11/2004	10469.84	1164.89	47.42	2.45614
11/12/2004	10539.01	1166.17	47.32	2.51497
11/15/2004	10550.24	1161.67	46.77	2.505952
11/16/2004	10487.65	1143.2	45.99	2.539877
11/17/2004	10549.57	1130.56	46.82	2.512195
11/18/2004	10572.55	1130.51	46.42	2.51497
11/19/2004	10456.91	1130.2	48.8	2.580247
11/22/2004	10489.42	1127.44	48.33	2.539394

11/23/2004	10492.6	1125.4	48.89	2.560976
11/24/2004	10520.31	1111.09	48.6	2.554217
11/26/2004	10522.23	1094.8	49.73	2.494253
11/29/2004	10475.9	1095.74	48.98	2.491429
11/30/2004	10428.02	1106.49	45.59	2.446927
12/1/2004	10590.22	1103.66	43.31	2.404372
12/2/2004	10585.12	1103.23	42.54	2.468208
12/3/2004	10592.21	1114.02	43.05	2.494118
12/6/2004	10547.06	1108.2	41.54	2.502959
12/7/2004	10440.58	1103.29	42.15	2.555556
12/8/2004	10494.23	1113.65	42.38	2.554878
12/9/2004	10552.82	1121.84	40.71	2.506024
12/10/2004	10543.22	1124.39	41.32	2.521212
12/13/2004	10638.32	1122.14	42.04	2.555556
12/14/2004	10676.45	1130.65	44.41	2.605096
12/15/2004	10691.45	1142.05	44.45	2.554878
12/16/2004	10705.64	1134.48	46.28	2.567073
12/17/2004	10649.92	1135.17	45.75	2.598765
12/20/2004	10661.6	1131.5	45.63	2.628931
12/21/2004	10759.43	1114.58	44.1	2.582822
12/22/2004	10815.89	1114.8	44.18	2.611111
12/23/2004	10827.12	1110.06	41.48	2.57485
12/27/2004	10776.13	1103.52	41.92	2.550296
12/28/2004	10854.54	1110.11	43.44	2.50289
12/29/2004	10829.19	1108.36	43.45	2.511765
12/30/2004	10800.3	1113.56	42.28	2.52381
12/31/2004	10783.01	1129.3	43.73	2.488235
1/3/2005	10729.43	1122.2	43.3	2.410112
1/4/2005	10630.78	1128.55	45.45	2.396648
1/5/2005	10597.83	1123.5	45.43	2.4375
1/6/2005	10622.88	1120.37	45.32	2.383333
1/7/2005	10603.96	1128.33	45.9	2.423729
1/10/2005	10621.03	1125.82	46.64	2.420455
1/11/2005	10556.22	1123.92	48	2.456647
1/12/2005	10617.78	1118.38	48.38	2.470588
1/13/2005	10505.83	1116.27	49.11	2.459302
1/14/2005	10558	1121.3	48.31	2.461988
1/18/2005	10628.79	1113.63	47.17	2.470588
1/19/2005	10539.97	1118.31	47.4	2.452941
1/20/2005	10471.47	1105.91	48.53	2.461538
1/21/2005	10392.99	1104.24	48.61	2.464286
1/24/2005	10368.61	1099.15	49.43	2.413793
1/25/2005	10461.56	1107.77	48.91	2.447674
1/26/2005	10498.59	1105.09	48.72	2.453488
1/27/2005	10467.4	1104.96	47.18	2.521212
1/28/2005	10427.2	1096.19	48	2.509091
1/31/2005	10489.94	1095.68	47.03	2.48503
2/1/2005	10551.94	1098.35	46.69	2.441176
2/2/2005	10596.79	1091.23	46.65	2.416185
2/3/2005	10593.1	1095.17	46.48	2.478788

2/4/2005	10716.13	1081.71	45.18	2.512346
2/7/2005	10715.76	1079.34	45.17	2.579618
2/8/2005	10724.63	1064.8	45.56	2.684564
2/9/2005	10664.11	1063.23	46.99	2.592357
2/10/2005	10749.61	1075.79	47.16	2.611465
2/11/2005	10796.01	1079.04	47.42	2.649351
2/14/2005	10791.13	1065.22	47.42	2.546584
2/15/2005	10837.32	1063.97	48.46	2.521212
2/16/2005	10834.88	1080.7	48.36	2.539394
2/17/2005	10754.26	1098.63	49.01	2.556886
2/18/2005	10785.22	1099.69	49.32	2.568862
2/22/2005	10611.2	1106.62	51.35	2.603659
2/23/2005	10673.79	1101.72	51.39	2.6
2/24/2005	10748.79	1100.43	51.24	2.603659
2/25/2005	10841.6	1095.42	51.49	2.564706
2/28/2005	10766.23	1094.83	51.72	2.591716
3/1/2005	10830	1084.07	51.61	2.591716
3/2/2005	10811.97	1086.2	53	2.597633
3/3/2005	10833.03	1096.84	53.46	2.618182
3/4/2005	10940.55	1093.88	53.78	2.644172
3/7/2005	10936.86	1108.67	53.54	2.622754
3/8/2005	10912.62	1100.9	54.89	2.553672
3/9/2005	10805.62	1101.39	54.29	2.545455
3/10/2005	10851.51	1106.69	53.14	2.505495
3/11/2005	10774.36	1111.47	54.43	2.483516
3/14/2005	10804.51	1115.14	55.02	2.494505
3/15/2005	10745.1	1114.35	54.71	2.52514
3/16/2005	10633.07	1112.81	56.59	2.583815
3/17/2005	10626.35	1109.11	56.3	2.548023
3/18/2005	10629.67	1118.33	56.72	2.516667
3/21/2005	10565.39	1116.21	57.24	2.475936
3/22/2005	10470.51	1125.38	55.43	2.401042
3/23/2005	10456.02	1128.94	53.84	2.421053
3/24/2005	10442.87	1140.84	54.84	2.391753
3/28/2005	10485.65	1136.2	53.74	2.408377
3/29/2005	10405.7	1133.35	54.4	2.412698
3/30/2005	10540.93	1134.43	54.39	2.513966
3/31/2005	10503.76	1140.65	55.59	2.519774
4/1/2005	10404.3	1144.06	57.27	2.497207
4/4/2005	10421.14	1134.41	56.8	2.475138
4/5/2005	10458.46	1130.3	55.82	2.466667
4/6/2005	10486.02	1135.02	55.85	2.427027
4/7/2005	10546.32	1132.05	53.87	2.445652
4/8/2005	10461.34	1133.56	53.32	2.445055
4/11/2005	10448.56	1132.01	53.73	2.531792
4/12/2005	10507.97	1125.29	51.38	2.517241
4/13/2005	10403.93	1136.47	50.38	2.540698
4/14/2005	10278.75	1131.33	51.18	2.556886
4/15/2005	10087.51	1142.18	50.49	2.572289
4/18/2005	10071.25	1140.42	50.62	2.598765

4/19/2005	10127.41	1122.5	53.87	2.6375
4/20/2005	10012.36	1116.64	53.64	2.60241
4/21/2005	10218.6	1124.99	54.25	2.645963
4/22/2005	10157.71	1121.2	55.39	2.613497
4/25/2005	10242.47	1120.68	53.9	2.578313
4/26/2005	10151.13	1121.28	54.12	2.575758
4/27/2005	10198.8	1114.94	51.21	2.651899
4/28/2005	10070.37	1113.05	51.7	2.614907
4/29/2005	10192.51	1095.41	49.72	2.614907
5/2/2005	10251.7	1093.56	50.73	2.567073
5/3/2005	10256.95	1089.19	49.43	2.576687
5/4/2005	10384.64	1088.68	50.39	2.58642
5/5/2005	10340.38	1091.49	51.3	2.532544
5/6/2005	10345.4	1084.1	50.96	2.538462
5/9/2005	10384.34	1095.7	52.46	2.563636
5/10/2005	10281.11	1096.44	51.74	2.567073
5/11/2005	10300.25	1097.28	50.01	2.518072
5/12/2005	10189.48	1095.45	48.34	2.481928
5/13/2005	10140.12	1087.12	48.67	2.487952
5/16/2005	10252.29	1098.7	48.82	2.512195
5/17/2005	10331.88	1113.99	49.16	2.466667
5/18/2005	10464.45	1121.53	48.83	2.431953
5/19/2005	10493.19	1119.55	49.09	2.473054
5/20/2005	10471.91	1117.49	48.65	