Spending and Buying: The Relationship Between Changes in the Federal Budget Deficit as a Percentage of GDP and Changes in the Stock Market.

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An Honors Paper

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Abstract

The central hypothesis of this thesis is that a negative relationship exists between the federal deficit as a percentage of GDP and stock market returns. Standard macroeconomic theory and the theory of financial markets, both support a negative relationship, but there are few direct empirical tests on it. The purpose of my paper is to explain why one would expect a negative relationship between the federal deficit and stock returns and then to empirically demonstrate that changes in the federal budget deficit as a percentage of GDP do exert a negative influence on stock market returns. Stock market returns represented the rate of change of the Standard and Poor's 500 Index. [1]

Approved:_____, June 3, 2004_____

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Introduction

The central hypothesis of this thesis is that a negative relationship exists between the federal deficit as a percentage of GDP and stock market returns. Standard macroeconomic theory and the theory of financial markets both support a negative relationship, but there are few direct empirical tests on it. The purpose of my paper is to explain why one would expect a negative relationship between the federal deficit and stock returns and then to empirically demonstrate that changes in the federal budget deficit as a percentage of GDP do exert a negative influence on stock market returns. Stock market returns represent the rate of change of the Standard and Poor's 500 Index.

The thesis will discuss three channels through which changes in the federal deficit can exert a negative effect the stock market, interest rates, inflation, and uncertainty. Conventional macroeconomic theory predicts that changes in the deficit will have a direct effect on interest rates, which in turn affect the stock market. The Federal Government is capable of influencing interest rates by running a deficit because it issues bonds to finance expenditures that exceed tax revenues. Increasing the supply of bonds can negatively affect their prices and force borrowers such as the Treasury Department to offer higher risk-free interest rates to attract purchasers. Treasury bonds are considered risk-free because the Federal Government can avoid default by raising taxes or altering the money supply to finance them. To the extent that government bond issues raise interest rates, they raise an investor's required return on stocks. Thus investors will continue to hold stocks only if they expect the price of the stock to increase at a higher rate that matches the higher return on bonds. (This argument abstracts from the relative riskiness of stocks, which is treated separately below.) It follows that current prices of

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bonds must fall, which implies a negative relationship between stock prices and risk-free interest rates.

Percentage changes in the CPI represent inflation by measuring changes in the real price of a basket of goods that is supposed to represent an average American household. Inflation as percentage changes in the CPI is pertinent to this hypothesis because it can occur in response to changes in the federal deficit and can negatively affect stock prices. Because an increase in the federal deficit puts upward pressure on interest rates, it can trigger increases in the money supply due to the Federal Reserve Board "monetizing" a portion of the deficit. The possibility that the FRB will monetize part or all of the deficit can in turn cause a change in expected inflation, and it can be assumed therefore that increases the federal deficit increase the likelihood that the Federal Reserve will intervene via "monetization".

It is generally thought that increased uncertainty bears a negative effect on stock market returns. Terrorist attacks; corporate or political scandals, disease, and military interventions are often associated with poor stock market performances. Increased uncertainty is a third product of increased deficit spending because it creates greater uncertainty concerning how the deficit will be "resolved," either by inflation due to "monetization," future tax liabilities to pay off the increased national debt, or decreased government spending in order to balance the budget and prevent further deficit spending. Uncertainty about future levels of "monetization" can entail greater creditor and debtor risk due to the increased uncertainty about future inflation because it can redistribute income between debtors and creditors in unintended directions. This greater uncertainty can translate into increased investment risk and cause investors to demand higher risk-

premiums, which cause them to have higher required stock-returns. This implies a negative relationship between revisions in expected inflation and current stock prices. Increased economic uncertainty additionally causes investors and corporations to be more pessimistic about corporate revenue growth, which lowers the expectation that a firm will pay future dividends and causes the demand for stocks, and thereby stock prices, to fall.

Literature and Theory Review

The supportive literature and theory for this paper's hypothesis is addressed in two stages. First, I examine the literature and theory connecting deficits to interest rates, inflation, and uncertainty. Then I turn to the effects of interest rates and inflation on stock returns. Finally, I note some literature claiming that deficits exert a direct influence on stock market prices. A substantial amount of literature and academic theory exists affirming the paper's hypothesis that positive changes in deficits as a percentage of GDP create upward pressures on interest rates and inflation, which in turn force stock prices to drop in order to increase future returns on stocks.

The Effects of Deficits On Interest Rates, Inflation, and Uncertainty

The relationship between increased government spending, interest rates, and inflation can be demonstrated using standard macroeconomic theory as represented in the IS/LM model[2]. The IS curve is downward sloping and represents goods market equilibrium, which requires that output be equal to the sum of consumption, investment, and government spending and net exports. The LM curve is upward sloping, representing the requirement that financial markets be in equilibrium. In particular, the

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[2] Diagrams from Dr. Jo Anna Gray, Economics 471, Class Packet, 34

demand for money must be equal to the supply of money. Equilibrium in all markets

occurs jointly at point **E,** the intersection of the two curves. In the diagrams of the IS-LM

model below, r denotes the real interest rate, y is aggregate real output, M is the money

stock, G is the level of real government spending, P is the aggregate price level, AD is

aggregate demand, and LRAS is long-run aggregate supply. The two graphs below show

changes in output that are caused by a bond-financed increase in government spending

and a money-financed increase in government spending. If the economy starts at full-

employment equilibrium at output Y_n, a price level of P_0, and interest rate r_0, a bond-

financed increase in government spending will cause the IS curve to shift outward from

$IS_0(G_0)$ to $IS_1(G_1)$ and will create an increase in aggregate demand, shifting $AD_0(G_0)$ to

$AD_1(G_1)$. While output may rise above the natural level, rising wages and prices will

make the increase in output unsustainable. This increase in wages and prices will cause

the economy to shift toward a new long-run equilibrium at E_1, and the LM curve to shift

leftward as increasing prices cause the real money supply to decline. This response to

will continue until rising wages and prices bring the economy back to its natural

production level, Y_n, and the higher price level P_1. In the long-run, therefore, a bond-

financed increase in government spending does not change output and leaves the

economy with higher interest rates and prices. A money-financed increase in government

spending occurs when the government finances a spending increase by printing more

money. In this case the IS curve will shift out the same amount as in the case of bond-

financed spending, as shown in figure two. In addition, however, the LM curve will shift

out as the government creates money to finance the increased expenditure. The increase

in interest rates will be smaller than under bond-financed spending. This is because the

LM curve shift places downward pressure on interest rates. In response to both the IS and LM curves shifting out, the change in output will be greater. Price, wage and interest rate increases again bring the economy back to its natural rate of output and rise in the long-run more than under bond-financed spending.

Either the public buys the bonds issued by the Treasury, to cover the federal deficit over the deficit period, or by the Central Bank, which results in an increase in high-powered money[3], and the money supply. A combination of high-powered money and treasury-issued bonds typically finance the deficit. The IS/LM diagrams show that regardless of whether a deficit is financed by treasury sales to the public, or by printing money, the interest rate and the price level will rise. However, in the case of money-finance, the fact that the money supply continues to increase as long as the deficit persists means that the LM and AD curves will continue shifting out period after period to maintain the G_1 level of government spending. This indicates that inflation can result from money-financed increases in government spending. Not all economic theory, however, supports a negative relationship between deficits and interest rates. Barro (1974) posits that government bonds create greater uncertainty about future risks of tax liabilities and encourage private households to save more, which can negatively influence interest rates and prevent the real rate from actually changing. Empirical evidence provides mixed support for the IS/LM model's prediction that deficits increase either real or nominal interest rates. Hoelscher's (1986) findings support a positive relationship between the deficit and interest rates for long-term bonds; he finds that yields on ten-year treasuries increased 195 basis points during the 1980-
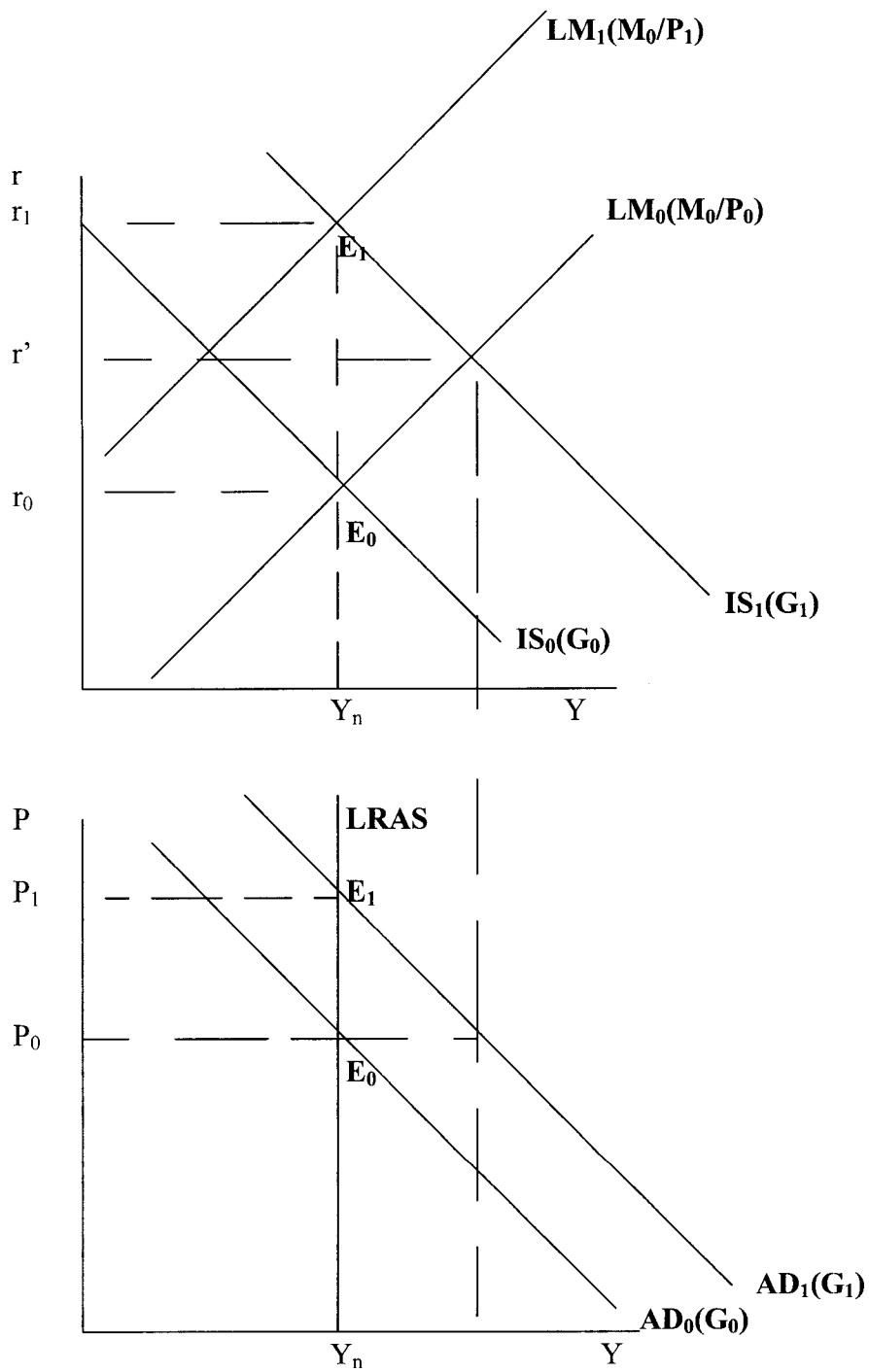
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[3] ibid

Figure One:
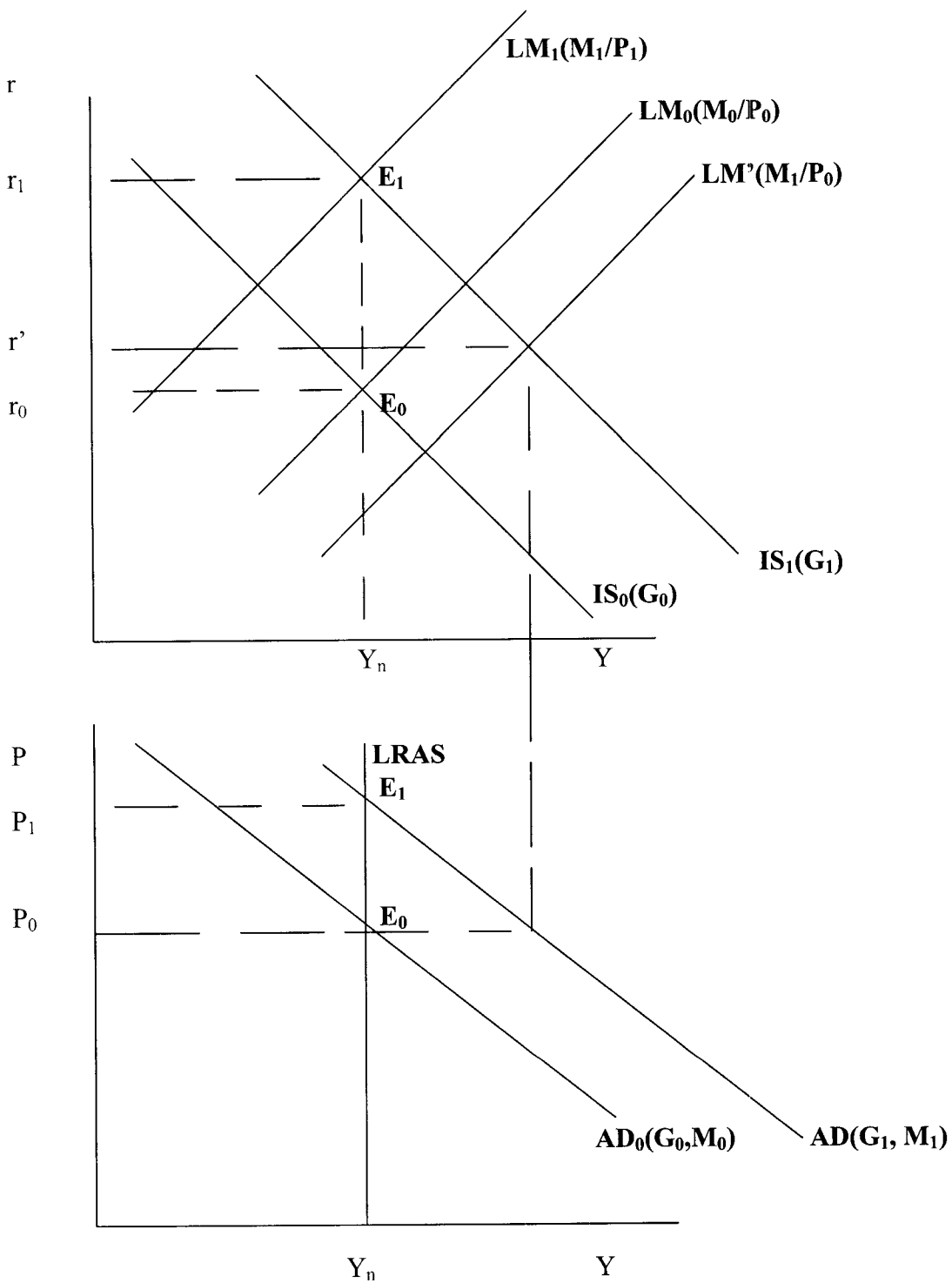**A Bond-Financed Increase in Government Spending**

Figure Two:
A Money-Financed Increase in Government Spending

1984 period when large deficits existed. Hoelscher explains the lack of an affect on short-term rates by suggesting that deficits drove long-term investors into short-term bond markets, increasing the demand for those bonds and lowering their yields relative to long-term bonds. De Leeuw and Holloway also conclude that interest rates positively respond to deficit changes. Evans (1985), however, examines deficit spending over the post World War II period and finds evidence supporting the Ricardian equivalence—the proposition that government spending financed by borrowing implies higher future tax burdens (due to the need to pay off the debt) and prompt a decline in household spending that prevents interest rates from rising. Deficit research therefore has produced mixed results.

Several channels exist through which increases in the federal deficit can lead to greater uncertainty. Knowledge of an increase in the federal deficit can cause increased expected future taxes to compensate for past spending to be paid off, higher expected inflation due to the central bank monetizing the debt, expected interest rate increases as a result from increased government borrowing, and higher risk premia due to the higher uncertainty in financial markets that the deficit creates. Thus, deficits cause considerable uncertainty about future taxes, inflation, interest rates, and expected returns.

The Effects of Interest Rates on the Stock Market

Assuming the relationship between deficits and interest rates is positive, the second link in the causal chain – a negative relationship between interest rates and stock returns – is supported by a wide variety of academic literature. Mishkin's text, *The Economics of Money, Banking, and Financial Markets* references the Gordon Growth

Model, also known as the Dividend Growth Model, which is based on investors'

expectation that their equities will eventually pay dividends, as one explanation for why

stock prices rise when interest rates drop. Rising interest rates in the Gordon Model

$$P_0 = \frac{D_0 \times (1+g)^1}{(1 + k_e)^1} + \frac{D_0 \times (1+g)^2}{(1 + k_e)^2} + \ldots + \frac{D_0 \times (1+g)^\infty}{(1 + k_e)^\infty}$$

where P_0 = the stock's final sales price
D_0 = the most recent dividend paid
g = the expected constant growth rate in dividends
k_e = the required return on an investment in equity

cause k_e to rise. Having higher required returns will cause the stock's current price to fall

through larger denominators (higher discount rates and hence lower present values) as

well as lowering the investor's dividend growth expectations.

Financial theory generally accepts that stock prices respond to interest rates. The

Capital Asset Pricing Model (CAPM), in which $E(r_D)$ is an asset's expected real return, r_f

is the risk-free rate, β_D is beta (the asset's covariance with the market), and $E(r_M)$ is the

expected market return clearly demonstrates how expected stock returns are directly

influenced by risk-free rates.

$$E(r_D) = r_f + \beta_D[E(r_M) - r_f]$$

Although CAPM criticisms abound (e.g. Roll's (1977) critique that it is

impossible to test since one cannot construct a complete market portfolio and Fama and

French's (1992) claim that beta adds nothing to return-predictions), the model

demonstrates how expected real returns rise as the risk-free rate rises, which means that current stock prices must fall.

The Effects of Inflation on the Stock Market

There are several leading papers from the 1980s addressing the stock market's negative relationship with the steeper inflation rate of the time. Geske and Roll (1983) find that increases in inflation causes stock prices to fall by a surprisingly large coefficient of one to five. This relationship seemed too drastic to be plausible and led to the conclusion that inflation's affect on stock prices was indirect or spurious rather than causative. Stock returns thereby should appear to respond negatively to expected inflation that may stem from adverse macroeconomic indicators such as supply shocks or corporate bankruptcies that will cause a decline in tax revenues, a deficit expansion and an increased likelihood of Federal Reserve debt monetization.

Fama's (1981) findings on inflation, real activity, and stock returns also found a negative relationship between inflation and real activity dating back to 1953. In these findings, Fama noted that the negative relationship between inflation and stock returns was spurious since it occurred via real activity and served as an approximation for interest rates. Fama's paper claimed therefore that inflation itself did not cause stock prices to drop, but rather its indicative power corresponded to negative equity movements.

Schwert's (1981) paper on stock price responses to unexpected inflation additionally noted a negative relationship between the two. Schwert asserted that unexpected inflation contained informative value about future levels of economic

activity. If expected future inflation rates were higher, present interest levels will adjust to capture the same real return. At the same time, unexpected inflation hurts those holding bonds with longer maturities, deterring long-term lending and economic growth. Unexpected inflation increases can also create economic uncertainty by causing governmental changes in monetary policy that are intended to offset increasing inflation.

The Effects of Uncertainty on the Stock Market

Increased uncertainty can have a negative affect on stock valuations in that the required average (expected) return on an asset increases when an investor becomes less confident about its return stream. Mishkin (2002) illustrates how recent stock market uncertainty grew in response to the terrorist attacks on September 11 and the Enron corporate accounting scandals, causing required returns on stocks to rise and prices to fall. Bodie's *Essentials of Investment* text further describes how uncertainty raises risk-premia in international investment, in that an American investor's lack of knowledge of another country's political and economic stability would cause them to have a higher required return on the investment. Again, the effect on current stock prices is expected to be negative.

Deficits Directly Affect the Stock Market

Although a negative relationship between deficit spending and stock market prices can be explained through the effects of deficits on inflation and interest rates, which then affect stock prices, very little prominent academic literature could be found that directly addresses this paper's hypothesis that deficit spending negatively affects

stock prices. Darrat and Brocato (1994) mention that the effect of the deficit on stock market movements should theoretically be negative due to the deficit's positive influence on interest rates, risk premiums, and inflation premiums. Their paper also illustrates how deficits can lower stock values by creating greater uncertainty about the future involvement of the Federal Reserve in financing it. Additional papers by Darrat (1990) and Ewing (1997) provide international evidence on the causality relationship between increases in the deficit and movements in the stock market. Darrat also finds that when additional macroeconomic variables such as interest rate volatility, real economic activity, inflation, the money base, and exchange rates are included in a regression on the Toronto Stock Exchange, Canadian budget deficits persistently had a lagged and depressing influence on the stock index and vice versa with surpluses. Ewing's follow-up 1997 paper examines the lagged effects of federal budget deficits on stock markets in Australia and France and finds them to be significant. Both these articles mention how little research has been devoted to directly examining the relationship between federal deficits and stock prices.

It is surprising to find such a lack of research directly examining the effects of deficits on stock prices. Studies of the effects of interest rates and inflation of stock prices are hampered by the high degree of endogenaity of these two explanatory variables – particularly interest rates. By contrast, the deficit can be argued to be relatively exogenous, making it a "better," "clearer" explanatory variable as well a more direct test of the theory.

Econometric Methodology

The empirical model for this paper is an ordinary least squares regression estimated with quarterly data. In equation (1) below, δ_t represents quarterly log-differenced changes in the Standard and Poor's Index, π_t represents quarterly log-differenced changes in the Consumer Price Index, θ_t represent the ratio of federal deficit to GDP, and δ_{t-1} is the lagged quarterly change in the Standard and Poor's 500 Index.

Model 1: $\qquad \delta_t = \alpha_0 + \beta_0 \, \pi_t + \beta_1 \, \theta_t + \beta_2 \, \delta_{t-1} + \epsilon_t$ $\hfill$ (1)

The model estimates with quarterly data from the start of 1952 through the second quarter of 2003. I obtained the Consumer Price Index, federal deficit and GDP data from the St. Louis Federal Reserve's FRED II website and the Standard and Poor's Index data from Wharton Business School at the University of Pennsylvania. I believe that the Standard and Poor's Index is the most suitable proxy for the stock market since it represents over eighty percent of the United States market capitalization.

It was necessary to include inflation in the equation because the left-hand-side variable (the variable to be explained, or the "dependent" variable) is nominal quarterly changes in the stock index, whereas theory suggests that the correct dependent variable is the expected real return on stocks. By including quarterly percentage changes in the CPI on the right-hand-side, we are adjusting for inflation and providing a better estimate of changes in the real value of the dependent variable. Additional regressions were inflation-adjusted with the dependant variable converted to real terms, δ_t is adjusted to be γ_t, consisting of δ_t- π_t, and δ_{t-1} also placed in real terms where δ_{t-1} is adjusted to γ_{t-1},

consisting of $\delta_{t-1} - \pi_{t-1}$. Both the deficit and GDP are measured in nominal terms, but their presentation, as the ratio deficit/GDP would factor out inflation. An inflation-adjusted equation is as follows:

Model 2: $\qquad \gamma_t = \alpha_0 + \beta_0\,\pi_t + \beta_1\,\theta_t + \beta_2\,\gamma_{t-1} + \epsilon_t$ $\qquad\qquad\qquad\qquad$ (2)

To divide changes in the CPI into expected and unexpected inflation, I regressed four quarterly lagged CPI terms against the constant term such that:

$$\pi_t = \alpha_0 + \beta_0\,\pi_{t-1} + \beta_1\,\pi_{t-2} + \beta_2\,\pi_{t-3} + \beta_3\,\pi_{t-4} + \epsilon_t \qquad\qquad (3)$$

where the error term ϵ_t is unexpected inflation and $\pi_t - \epsilon_t$ provides expected inflation. This distinction is useful if the inflation variable takes on a causality role, as the Geske and Roll (1983), Fama (1981), and Schwert (1981) papers implied, in addition to converting nominal changes in the stock index into real ones. Darrat and Brocato (1994) also support the claim that financial assets are not neutral to changes in expected inflation. To better explain the unexpected causal influence of inflation on the stock market, I run a third regression where CPI changes are separated into expected inflation, τ_t, which consists of the estimated value of π_t generated in equation (3), and unexpected inflation, υ_t, which consists of the residual error term ϵ_t generated in equation (3).

Model 3: $\qquad \delta_t = \alpha_0 + \beta_0\,\upsilon_t + \beta_1\,\tau_t + \beta_2\,\theta t + \beta_3\,\delta_{t-1} + \epsilon_t$ $\qquad\qquad\qquad$ (4)

Both τ_t and υ_t are "generated regressors" and therefore their estimates that do reflect the true values of expected and unexpected inflation. Since τ_t and υ_t are estimates of expected and unexpected inflation that are measured with error, rather than their "true" values, the equation will be somewhat inefficient, placing downward pressure on model four's t-scores. In the case of τ_t and υ_t being insignificant, a Maximum Likelihood Estimate could be used as an alternative.

Including a lagged dependant variable in the regression is appropriate in the presence of serial correlation. This paper uses test for the presence of heteroskedastic error terms in the model by using a White's Statistic. Given normally distributed error terms, then including δ_{t-1} or γ_{t-1} will correct for serial correlation and allow the estimate to be consistent since the sample is large (205 samples). Durbin's h-test, which is an improved indicator for correlation in the presence of lagged dependent variables, further tests for serial correlation.

Results and Interpretation of First Model

The results of estimating model 1 support the theory that increases in the federal deficit exert a negative influence on the stock market returns. The h-statistic fails to reject the null that there is no serial correlation and the White's General Test Statistic fails to find heteroskedasticity among the error terms, which are visible on the graph plotting the predicted values and residuals. The CPI coefficient suggests a negative relationship between inflation and the stock market, which is consistent with Fama's (1981) findings.

Results and Interpretation of Second Model

As in model 1, inflation-adjusted model 2 purports a negative relationship between changes in the federal deficit as a percentage of GDP and real changes in the stock market. These results add support to the hypothesis because they are not skewed by inflation rates. Models 1 and 2 give coefficients that are nearly identical for the ratio of federal deficit to GDP and lagged quarterly change in the Standard and Poor's 500 Index in terms of coefficient values and significance levels. A hypothesis test for serial correlation via the h-statistic again fails to reject a null of no serial correlation with roughly the same results as in model one. Heteroscedasticity also is insignificant according to the White's general test, though the graph illustrates how there is an overall larger variance of the error terms. The largest difference between model 1 and 2 is the inflation coefficient, which is more negative in model 2.

Results and Interpretation of Fourth Model

Model 4, which divided π_t up into regressed estimates of expected inflation, denoted as τ_t, and unexpected inflation, denoted as υ_t, is included to explain the relationship between inflation and the stock market in greater detail. Since the π_t coefficient on models one and two was strongly negative, rather than a smaller positive number that was expected, it would be educational to further explain the inflation-stock return relationship. The difference in coefficients that I obtained from dividing inflation into expected and unexpected confirms the proposition that unexpected inflation has a more powerful negative impact on stock market returns than expected inflation does. While a certain margin of error exists because both expected and unexpected inflation are

"generated regressors" rather than "true" values of expected and unexpected inflation, both coefficients are significant at a five-percent level. These results have implications about how significantly surprise inflationary actions by the Federal Reserve can powerfully reduce investor wealth.

Model 4 has coefficients on the ratio of federal deficit to GDP and on the lagged quarterly change in the Standard and Poor's 500 Index that are similar to those of model 1 and 2. Serial correlation and heteroskedasticity are not evident using the Durbin's h-test and White's general test-statistic. The deficit coefficient is slightly smaller in this model.

Conclusion

This paper empirically examines how current changes in the federal deficit as a percentage of current gross domestic product influence present changes in the stock market and hypothesizes a negative causality relationship between the two. This paper's findings support its hypothesis and assert that a one-percent increase in the deficit as a percentage of GDP will negatively affect current stock prices by roughly one-fifth of a percentage point. It is likewise plausible that decreases in the deficit, as a percentage of GDP will have identical positive effects on the stock market. The size of the negative relationship also indicates that it would take large quarterly increases in the federal deficit as a percentage of GDP to have a powerful negative impact on the stock market. The nominal deficit grew as a percentage of nominal GDP by 0.3% during the first quarter of 2004, which this model implies would affect stock market values by -0.06%. This alone does not imply a severe response to increased deficit spending as a percentage of GDP

from the stock market. Investors could still benefit from this information both because of its implications about how deficits influence interest rates and inflation as well as the negative systematic influence the deficit exerts upon the stock market as represented by the Standard and Poor's 500 Index, which represents roughly eighty percent of the United States equity market. Increases in the deficit as a percentage of GDP would therefore have numerous implications to investors because they can provide additional reasons to expect stock prices to be negatively affected, interest rates to rise, inflation to rise, and economic uncertainty to increase. In conjuncture with Darrat and Broccato's reflections, it is surprising to have found such a scarcity of literature further examining the relationship between deficit spending and the stock market considering the statistical significance of the deficit and the numerous implications it provides towards how important components of financial markets like interest rates, inflation, and economic uncertainty will change. While this paper's findings support its hypothesis that increases in the federal deficit as a percentage of GDP exert a negative influence upon the stock market, the relationship is not commanding albeit significant. It is my conclusion that increases in deficit spending insinuate more towards how interest rates, inflation, and economic uncertainty will respond rather than how the stock market itself will respond. The multiple avenues for further financial economic research on this subject make it an attractive topic to further explore.

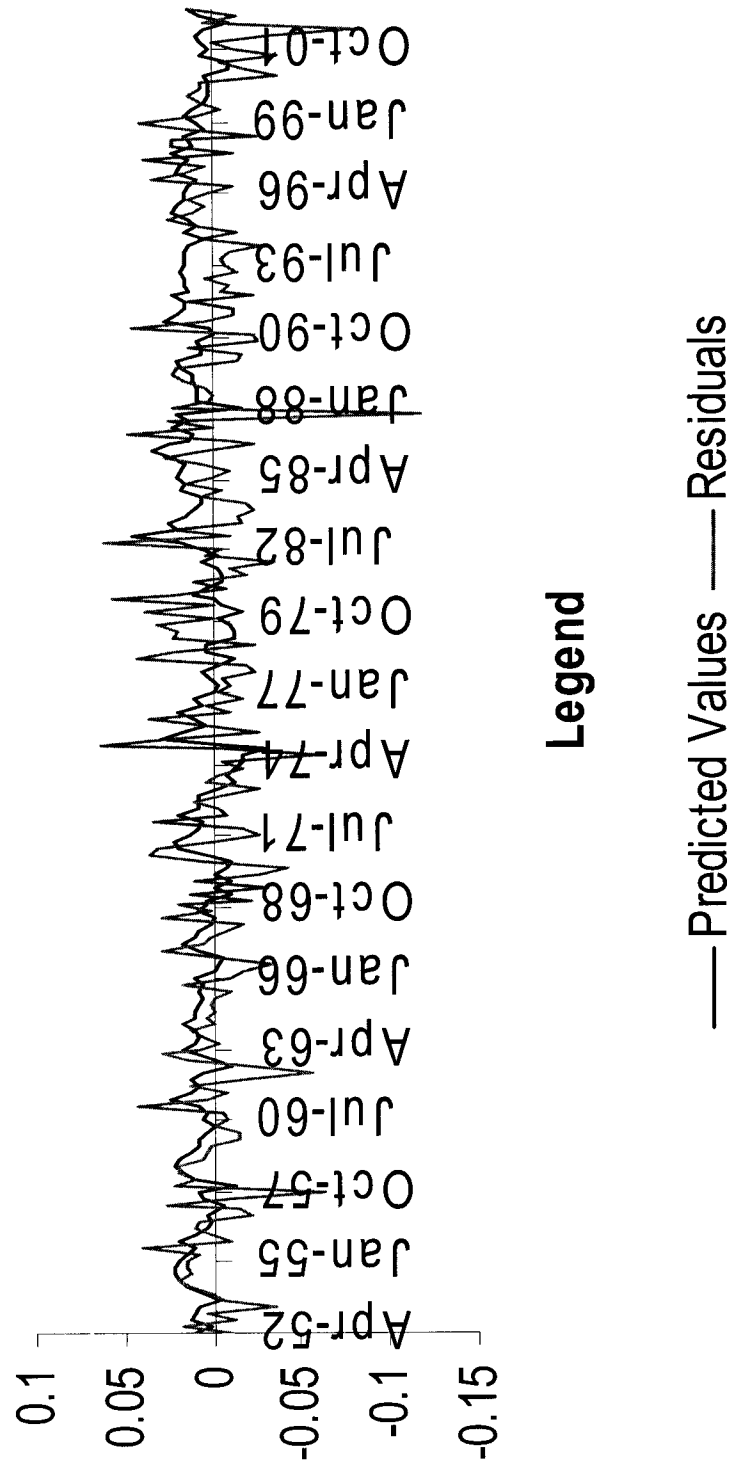# Figure 1: Predicted Nominal Returns on the S&P Using Model 1

Legend

——Predicted Values ——Residuals

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Table 1: Estimates of Model 1

	df	SS	MS	F	Significance F
Regression	3.0000	0.0232	0.0077	14.2571	0.0000
Residual	201.0000	0.1088	0.0005		
Total	204.0000	0.1320			

Regression Statistics	
Multiple R	0.4189
R Square	0.1755
Adjusted R Squar	0.1632
Standard Error	0.0233
Observations	205.0000

	Coefficients	Standard Error	t Stat	P-value
α_0	0.0095	0.0028	3.4353	0.0007
π_t	-1.6401	0.4970	-3.3000	0.0011
δ_{t-1}	0.2910	0.0655	4.4437	0.0000
θ_t	-0.2073	0.0836	-2.4782	0.0140

Durbin-Watson d-statistic (4, 205) = 1.9373
h-test for autocorrelation:

$Chi^2 = 1.472$ $\qquad$ df = 1 $\qquad$ Prob > $Chi^2 = 0.2251$
White's general test statistic: 4.3686 $\qquad$ Chi^2 (9) $\qquad$ P-value = 0.8855

Figure 2: Predicted Real Returns on the S&P Using Model 2

Legend

—— Predicted Values —— Residuals
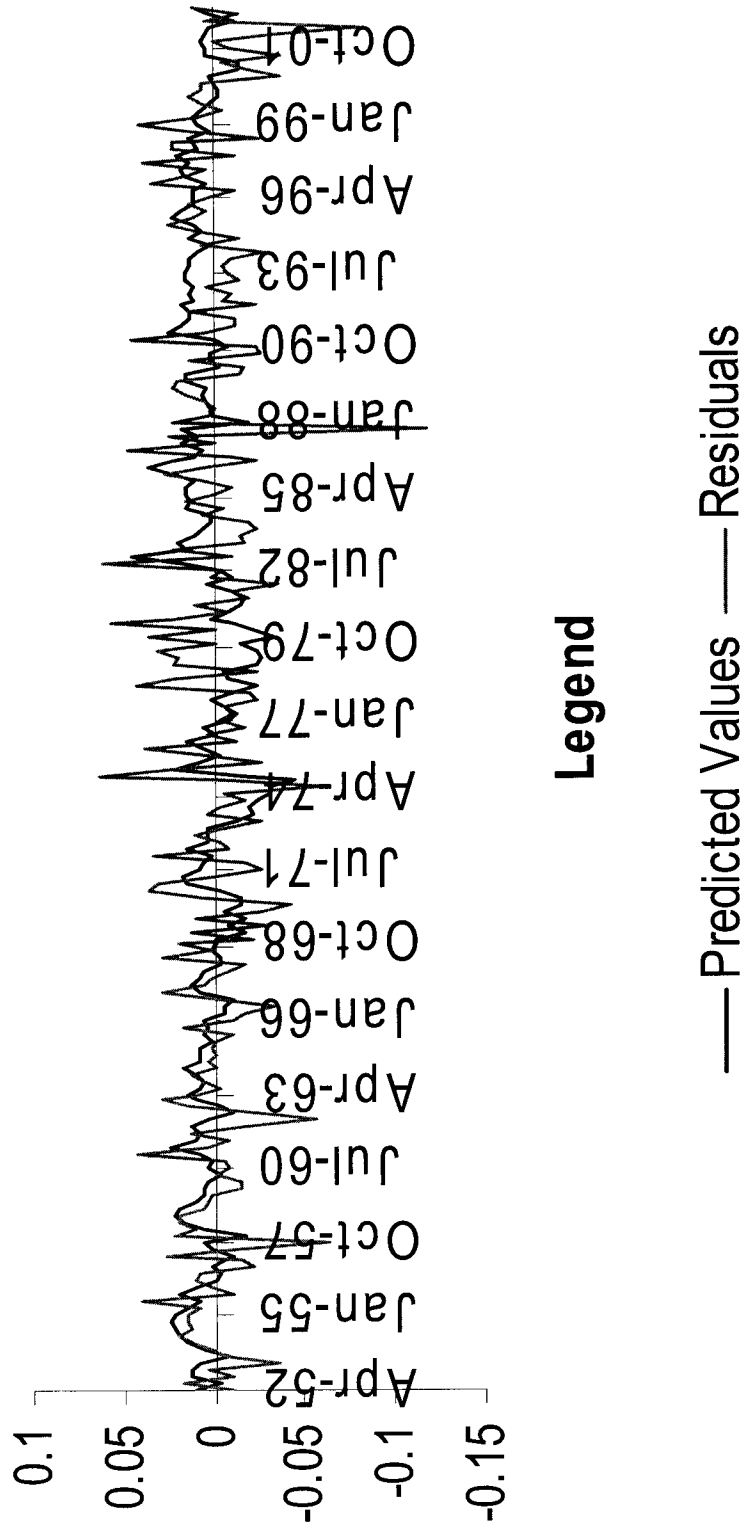
Table 2: Estimates of Model 2

	df	SS	MS	F	Significance F
Regression	3	0.034025002	0.01134	20.9417	7.57142E-12
Residual	201	0.108858066	0.00054		
Total	204	0.142883067			

Regression Statistics	
Multiple R	0.4880
R Square	0.2381
Adjusted R Square	0.2268
Standard Error	0.0233
Observations	205.0000

	Coefficients	Standard Error	t Stat	P-value
α_0	0.0096	0.0028	3.4539	0.0007
π_t	-2.5553	0.5012	-5.0990	0.0000
θ_t	-0.2083	0.0836	-2.4915	0.0135
γ_{t-1}	0.2898	0.0653	4.4378	0.0000

Durbin-Watson d-statistic $(4, 205) = 1.9338$

h-test for autocorrelation:

$Chi^2 = 1.551$ $\qquad$ df $= 1$ $\qquad$ Prob $> Chi^2 = 0.2130$

White's general test statistic: 4.4910 $\qquad$ Chi^2 (9) $\qquad$ P-value $= 0.8762$

Figure 3: Predicted Nominal Returns on the S&P Using Model 3

Legend
——Predicted Values ——Residuals
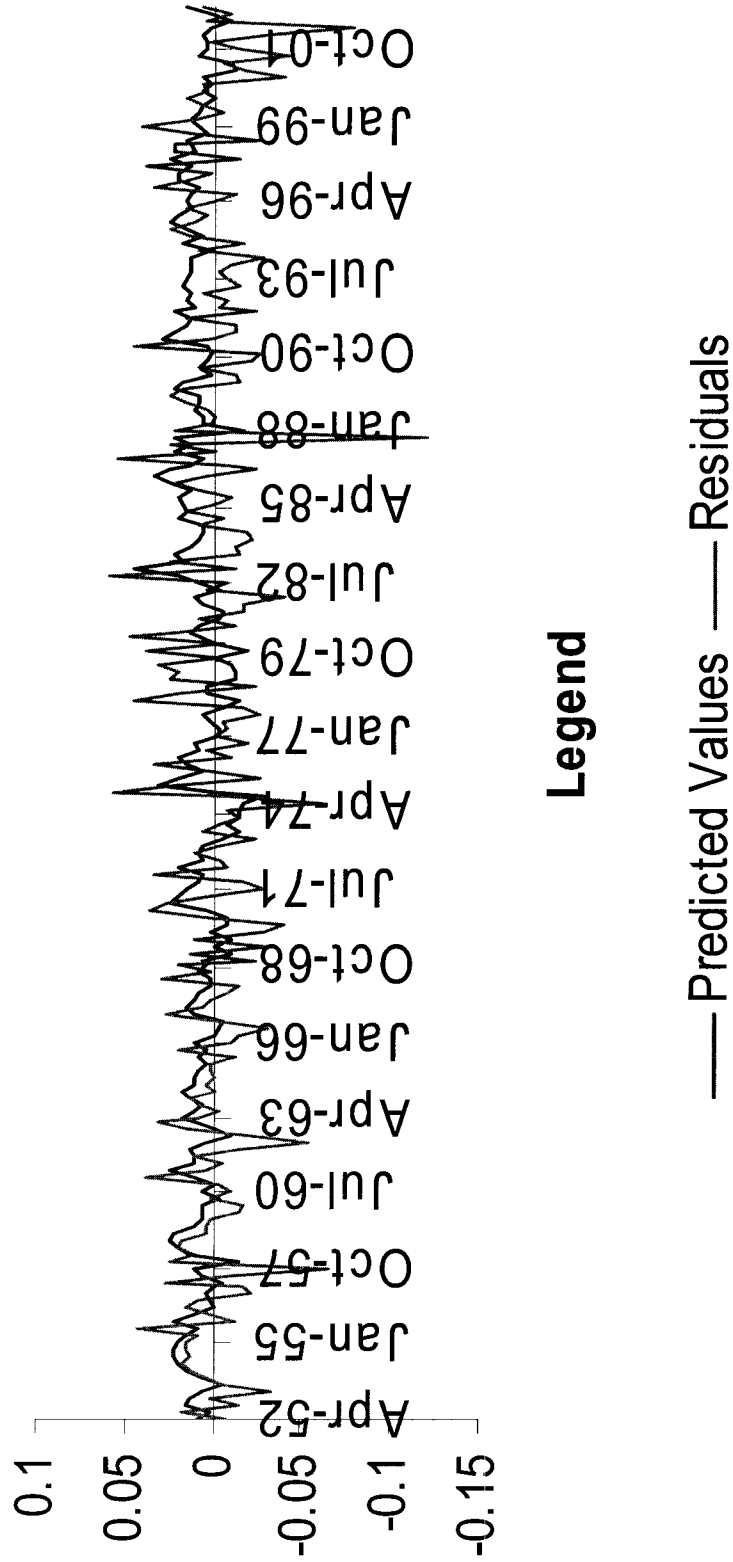
Table 3: Estimates of Model 3

	df	SS	MS	F	Significance F
Regression	4.0000	0.0240	0.0060	11.1028	0.0000
Residual	200.0000	0.1080	0.0005		
Total	204.0000	0.1320			

Regression Statistics	
Multiple R	0.4263
R Square	0.1817
Adjusted R Square	0.1653
Standard Error	0.0232
Observations	205.0000

	Coefficients	Standard Error	t Stat	P-value
α_0	0.0083	0.0029	2.8333	0.0051
θ_t	-0.1798	0.0864	-2.0804	0.0388
δ_{t-1}	0.2973	0.0656	4.5320	0.0000
υ_t	-2.7383	1.0178	-2.6904	0.0077
τ_t	-1.2715	0.5791	-2.1958	0.0293

Durbin-Watson d-statistic (4, 205) = 1.9815
h-test for autocorrelation:
Chi^2 = 0.140   df = 1   Prob > Chi^2 = 0.7087
White's general test statistic: 10.3896 Chi^2 (14)   P-value = 0.7332

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