Fiscal Policy, Monetary Policy, and the Stock Market

Abstract

This paper examines the dynamic linkages among the federal budget deficit, monetary policy and the stock market for the 1960 to 2004. The empirical results generally suggest that deficits matter for the stock market and imply a violation of the Ricardian Equivalence Proposition. Further analyses using taxes and government spending show a higher sensitivity of the stock market to taxes relative to spending. When replacing market returns with before- and after-tax corporate profits and excess market returns, we observe several economically significant results. For instance, unexpected increases in the fed funds rate lower expected stock returns leading to lower corporate profits and, thus, ultimately lower corporate tax revenues. Finally, the explicit modeling of inflation along with the deficit, fed funds rate and stock prices indicates a negative response of the stock market to innovations in inflation a result taken to suggest that the stock market pays attention to inflation information before pricing assets.

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I. Introduction

There is an overwhelming empirical literature on the issue of monetary policy and stock market behavior for the US and other countries (see, for instance, Bordo and Wheelock, 2004; and Laopodis, 2006, and the references therein) for obvious reasons. For example, assume a change in one of the monetary policy instruments like the money supply or the federal funds rate. Such a change leads to changes in market interest rates which force investors to revalue their equity holdings. In other words, the value of their wealth, given by the sum of the discounted future cash flows (and/or dividends), is affected by an easing or tightening of monetary policy through either the discount rate or expected earnings (or both).

By contrast, very few studies have focused on the relationship between fiscal policy (budget deficits) and stock market behavior. More specifically, these studies examined primarily stock market efficiency with respect to fiscal actions [e.g., Rogalski and Vinso, 1977; Darrat, 1988; Darrat and Brocato, 1994; and Lee, 1997]. No study, to the best of our knowledge, has investigated empirically how fiscal policy (as well as monetary policy) and the stock market have been interacting intertemporally. Although the theoretical motivation on the effects of fiscal policy on the stock market (or asset prices) have been laid out more than thirty years ago [e.g., Tobin, 1969; Blanchard, 1981; and Shah, 1984], the empirical front on the issue has been lagging, both for the US and other countries [see, for instance, Darrat, 1988; and Ali and Hasan, 2003, for two studies on (the efficiency of) Canada's equity market]. Perhaps this was due to the assumption of Barro's (1974) Ricardian Equivalence Proposition (of debt-neutrality), which asserts that deficits do not matter if individuals correctly expect and discount future tax increases from current tax decreases thus leaving their net worth unaffected. Subsequent investigations, however, have produced mixed results. For instance, while some studies have shown support for the proposition, [for instance, Evans, 1987a,b; and Boothe and Reid, 1989], others have produced results to the contrary [for instance, Frenkel and Razin, 1986; Darrat, 1986; and Zahid, 1988].

Theoretically, fiscal policy actions (changes in expenditures or taxes resulting in budget deficits or surpluses) play a significant role in the determination of asset prices. For example, increases in taxes, with government spending unchanged, would lower (expected) asset returns (or prices) as they discourage investors from (further) investing in the stock market. Also, increases in government borrowing raise the (short-term) interest rate which, in turn, lower the discounted cash flow value from an asset (like a share) and thus signals a reduction in stock market activity (aside from other adverse effects in the general economy). In the latter case, if high(er) interest rates threaten to choke off (future) economic activity, then the Fed Reserve might step in to reverse this undesirable situation (and so, monetary policy might interact with fiscal policy).

Therefore, in view of the above considerations, the aim of this paper is to fill the gap in the empirical financial literature by investigating the extent to which stock prices (or returns) incorporate all publicly available information on fiscal policy moves. This will be examined for the case of the US using quarterly observations from 1960 to present, employing econometric methodologies such as Granger causality, vector autoregressions and cointegration. To avoid any bias in the estimation and to abide by sound economic theory, we will also incorporate some monetary variables (namely, the interest rate and/or the money supply) in the estimation of the models, as suggested above.

The significance of the study is threefold. First, it would be interesting to find out whether the stock market offers an important channel for transmitting (the impact of) fiscal policy to the financial (and real) side of the economy. Second, if the stock market is not efficient with respect to fiscal policy information then private sector investor actions could profitably exploit the stock market, at least in the short-run. Finally, from the perspective of businesses, large budgetary deficits undercut investments in financial assets like stocks and bonds and real assets like plant and equipment by driving interest rates higher (that is, we have the so-called 'crowding-out effect') which, in turn, curtain economic growth.

The remainder of the paper is structured as follows. Section II considers the empirical methodological design of the study by outlining the theoretical and empirical considerations of the impact of fiscal (and monetary actions) on stock returns. Section III presents the empirical results and discusses them at length. Section IV extends the empirical analysis using alternative variable specifications and explicitly examines the impact of inflation. Section V performs several robustness tests and, finally, section VI summarizes the study and concludes with some general observations.

II. Methodology and Data

1. Theoretical considerations

In general, from the investors' perspective large budgetary deficits adversely impact stock and bond prices because they increase interest rates. That is because the government, being a large borrower, soaks up large amounts of funds that otherwise would have been available for the private sector, and thus drives up interest rates (that is, it 'crowds out' private spending/investment). The increase in interest rates, in turn, will reduce business capital spending (as well as consumption expenditures) and ultimately undermine real economic activity. These events will affect the financial markets by reducing asset prices and household wealth, further raising the cost of borrowing and reducing business spending. Ultimately, higher interest rates and weaker (real) economic activity may further deteriorate the fiscal imbalance potentially triggering another round of such negative effects reinforcing thus the vicious circle.

The adverse consequences of *sustained*, long-run budget deficits may be larger than the conventional analysis suggests. Conventional analysis suggests that sustained budget deficits have severe implications on interest rates, national saving and the external account (see, for example, Gale and Orszag, 2003, 2004; Engen and Hubbard, 2005). Thus, going beyond the traditional analysis, large future deficits entail additional risks to the economy which include a loss in (domestic and foreign) investor confidence and adverse effects on the exchange rate. Specifically, a loss in investor (and business) confidence would cause a shift of portfolios away from home-currency assets into foreign-currency assets, thereby placing a downward pressure on the domestic currency (and an upward pressure on the interest rate), which would limit the ability of the country to finance its liabilities and increase the country's exposure to exchange rate fluctuations. This situation, in turn, could undermine capital spending and ignite a drop in asset prices which would further restrain real economic activity (see, also, CBO, 2005).

Tobin (1969), in his general equilibrium approach of the financial sector, highlighted the role of stock returns as the linkage between the real and the financial sectors of the economy and showed how both money growth and budget deficits can have an important impact on stock returns (see, also, the theoretical discussion/models put forth by Blanchard, 1981, and Shah, 1984). It is well-known, after all, that government actions (or fiscal decisions) are likely to influence future monetary policy actions (see Thorbecke, 1997; and Patelis, 1997). For instance, actions by the government authorities that increase spending (and add to existing debt) are likely to increase the interest rate. To the extent that a higher interest rate will put a pressure on economic growth, the Fed will (be forced to) act to reverse (or ease) that pressure by increasing money supply (or decreasing its main policy tool, the federal funds rate). Therefore, it is necessary to explicitly include a monetary policy variable in the investigation of the dynamics between fiscal policy and the stock market.

Based on theory and empirical evidence, the expected directional impact of the budget deficit on stock returns should be negative. Following the above discussion, government budget deficits exert upward pressure on the (nominal) interest rate (or the discount rate, as applied to the firm) which, in turn, lowers expected returns (as the risk premium increases, see Geske and Roll, 1983). Geske and Roll also note that increases in risk premia, due to federal deficits, expose investors to an uncertainty surrounding the (re)action of the Federal Reserve and thus further confound the equity market.

By contrast, higher government deficits may also encourage higher money growth, resulting in an 'accommodative' behavior from the Federal Reserve or a decline in interest rates. Empirical evidence on this behavior has offered mixed results. Specifically, Allen and Smith (1983) and Barnhart and Darrat (1989) report a negative relationship between federal deficits and money growth, whereas DeLeeuw and Holloway (1985) and Hoelscher (1986) provide evidence of a positive linkage between the two. Therefore, this is still an issue to be further established empirically.

Additionally, the effects of money growth on stock returns can be approached from two theoretical perspectives, namely the efficient market approach (Cooper, 1974; and Rozeff, 1974) and the (general equilibrium) portfolio approach. The first approach simply argues that all past information incorporated in the money supply data is reflected in current stock returns and so money supply changes should have no impact on stock returns (except, perhaps, a contemporaneous effect). The second perspective suggests that investors attempt to hold an equilibrium position among all assets, including money and equities. An exogenous shock that increases the money supply would temporarily disturb this equilibrium until investors substitute money for other assets (including stocks). So, equities respond to monetary disturbance with a lag (and that lag could, theoretically, be linked to an interest-rate effect, a corporate-earnings effect, a risk-premium effect and so on (see Hamburger and Kochin, 1971, on this).

Finally, the conventional wisdom about the role of stocks is that they provide a hedge against inflation or that the Fisherian hypothesis, that the nominal equity returns should be positively related to inflation, holds. However, evidence provided by Fama and Schwert (1977), Geske and Roll (1983), and McCarthy et *al.* (1990) suggests a negative relationship between stock returns and inflation. A re-examination of the issue by James et *al.* (1985), Wei and Wong (1992), and Lee (1992) found support of this hypothesis, while Park (1997), Siklos and Kwok (1999) and Laopodis (2006) found evidence against it. Thus, this issue is still stirring empirical controversy and remains to be empirically solved.

2. Data and Preliminary Statistics

We utilize quarterly data on the variables to be described below for forty-five years, from 1960:I to 2004:IV. The basic sources for all series are *DataStream*, and the Federal Reserve's *FRED* online site. The original series are: GBD_t (the government budget deficit, cyclically adjusted, in millions of US dollars); GDP_t (the gross domestic product, in billions of U.S. dollars (1984=100)); CPI_t (the price index, proxied by the consumer price index (1984=100), seasonally adjusted); MS_t (the money supply, in billions of US dollars, seasonally adjusted, proxied by M1); $S\&P_t$ (the S&P500 index); TB_t (the Treasury Bill rate); and FFR_t (the effective federal funds rate).

Based on the series above, we construct the following basic variables to be included in the model estimation.

. BDY_t : budget deficit, as a percentage of GDP

. MS_t : money supply (= $\log(MS_t)$)

. SP_t : nominal stock prices (=$\log(S\&P_t)$)

. EMR_t : excess return on market (= $SP_t - TB_t$)

. INF_t : inflation rate (=$\log(CPI_t/CPI_{t-1})$

Table 1 contains some descriptive statistics on the deficit, (logarithm of) money supply, (logarithm of) stock prices and the federal funds rate variables. From the table we can see that the government's budget was consistently negative, with the exception of the years of 1999 and 2000, and reached a record in 2004. We also observe that the money supply has the smallest standard deviation, followed by the stock prices. The correlations among the four variables range from the lowest between the deficit and stock prices (-0.3407) to the highest (0.9059) between the money supply and stock prices. Another notable finding is almost null correlation (0.0553) between the federal funds rate and the money supply.

Finally, the pairwise Granger causality test results, in general, do not reveal any evidence of uni- or bi-directional causality between any pair of variables for the entire period. An exception is the evidence that the money supply does Granger-cause the federal funds rate and a marginal evidence of the reverse. Note, however, two things about these findings. First, that the series are in logs and not in returns or growth rates, and second, that the correlations and causality tests are simple measures and do not fully reflect the underlying linkages among the variables and so a more robust approach is needed to which we now turn.

3. Model Specification

Since the task here is to estimate the empirical relationship(s) between fiscal policy, monetary policy, and the stock market, while placing as few theoretical restrictions as possible on the system's variables, we will use the vector autoregression (VAR) framework. The general form of a VAR model is given by the following unrestricted (reduced-form) system:

$$Z_t = \alpha + \psi(L)Z_t + \upsilon_t \quad (1)$$

where Z_t is a vector of the *n* (stationary endogenous) variables, α is an *n x 1* vector of constants, $\psi(L)$ is an *n x n* matrix of (lagged) polynomial coefficients, and υ_t is an *n x 1* vector of white noise innovation terms (with $E(\upsilon_{tk}) = 0$ and $E(\upsilon_{tk}, \upsilon_{sk}) = 0$ for $t \neq s$). The disturbance term, υ_t, also has a covariance matrix, $E(\upsilon_t, \upsilon_t') = \Sigma$. Finally, the lag operator is defined as $\psi(L) = \psi_1 + \psi_2 L + \ldots + \psi_k L^{k-1}$ of degree $k - 1$ and ψ_j, for $j = 1, \ldots, k$.

More specifically, the 3-equation VAR system can be expressed as follows:

$$\Delta BDY_t = \alpha_1 + \sum_{i=1}^{n}\lambda_{1,i}\,\Delta BDY_{t-i} + \sum_{i=1}^{n}\kappa_{1,i}\,\Delta SP_{t-i} + \sum_{i=1}^{n}\nu_{1,i}\,\Delta M_{t-i} + \varepsilon_{1,t} \quad (1a)$$

$$\Delta SP_t = \alpha_2 + \sum_{i=1}^{n}\lambda_{2,i}\,\Delta BDY_{t-i} + \sum_{i=1}^{n}\kappa_{2,i}\,\Delta SP_{t-i} + \sum_{i=1}^{n}\nu_{2,i}\,\Delta MS_{t-i} + \varepsilon_{2,t} \quad (1b)$$

$$\Delta MS_t = \alpha_3 + \sum_{i=1}^{n}\lambda_{3,i}\,\Delta BDY_{t-i} + \sum_{i=1}^{n}\kappa_{3,i}\,\Delta SP_{t-i} + \sum_{i=1}^{n}\nu_{3,i}\,\Delta MS_{t-i} + \varepsilon_{3,t} \quad (1c)$$

where *BDY*, *MS*, and *SP* are as defined above, γ_i, λ_i, ν_i, and κ_i are parameters to be estimated, Δ is change, and $\varepsilon_{i,t}$ (i = 1 to 3) are stationary random processes describing the error terms. The n*i*'s (i = 1 to *n*) are the optimal orders of the autoregressive process for a given variable, in view of the use of quarterly observations.

Equations (1a to 1c) serve as an appropriate framework for evaluating the dynamic short-run interactions between deficits, money supply, and the stock market. Specifically, dynamics among the three variables are captured by κ_i, λ_i and ν_i coefficients. For instance, if one or more of κ_i coefficients is nonzero and statistically significant, then movements in the stock market will have short-run effects on the deficit and the money supply. Similarly, if one or more of ν_i coefficients is nonzero and significant, then movements in the money supply will have short-run effects on the stock market and/or the deficit.

If the above estimated coefficients are jointly found to be statistically significant, then past values of a given variable can explain variations in the other variable and the null hypothesis can be rejected. Finally, since determining the optimal lag structure of equations (1a - 1c) is a concern that needs to be addressed, for if the lag structure is mis-specified the empirical results may be biased, the use of Akaike's (1976) Final Prediction Error (FPE) criterion will be employed. The values of the criterion will determine the optimal lag structure of the n*i*'s. Briefly, the FPE is specified as follows:

$$FPE_{\Delta BDY}\ (p,k) = \left\{\frac{T + p + k + 1}{T - p - k - 1}\right\} \left\{ \sum_{t=1}^{T} \frac{(\Delta r_{i,t} - \Delta^{p} r_{i,t})^2}{T} \right\} \qquad (2)$$

where T is the number of observations, ΔBDY_t is the actual change in the budget deficit from period *t-1* to *t*, $\Delta_{pBDYi,t}$ is the predicted change in the variable during the same period and (p, k) is the lag structure that minimizes the FPE. The predicted value is obtained by OLS regression on equation (1a) with a pre-selected lag structure on $\Delta BDY_{i,t-i}$. Naturally, a similar FPE specification exists for the SP and the MS variables. The first bracketed term of equation (2) captures the estimation error, while the second term measures the average modeling error. In essence, Akaike's criterion balances the bias from choosing too small a lag order with the increased variance (inefficiency) of a higher lag-order specification.

Finally, the *atheoretical* nature of the VAR analysis and the presence of a large number of estimated parameters render the interpretability of these parameters difficult. This is further accentuated by the possibility of having coefficients with alternating signs across lags with not all of them being statistically significant (a possibility very real in our exercise). Therefore, one could not see the effect of a given variable on another variable within the VAR system. Fortunately, this problem can be partially mitigated by the use of a parameter block significance tests (based on the Wald χ^2 statistic), the computation of the variance decompositions and the impulse response graphs.

III. Empirical Findings and Discussion

1. Main Empirical Findings

Preliminary statistical investigation on the three variables, including unit root tests and cointegration analyses, did not show evidence of cointegration among the three variables (budget deficit, money supply and stock prices) and thus we will proceed with the estimation of the basic, that is, without an error-correction term, VAR model (these statistical results are available upon request).

In Table 2 the multivariate VAR estimates are presented, along with some regression diagnostics (i.e., the R-square, adjusted R-square, the standard error of the regression, an F-statistic, the Log Likelihood function, and Akaike's FPE). The FPE criterion has indicated two lags (i.e., quarters) as the optimal lag length for this specification (the results are not reported but are available upon request). Overall, based on these diagnostics, it can be inferred that all models seem to explain well the dynamic linkages among the variables.

The VAR results indicate some short-run, reciprocal effects between the budget deficit and the stock returns but no such linkages among these two magnitudes and the money supply (growth). Specifically, for the first variable pair it is observed that the budget deficit positively affects the stock market with a one-quarter lag and negatively with a two-quarter lag (but insignificantly). Most importantly, however, are the movements in the stock market which affect the deficit in a positive manner, that is, advances in the stock market increase the (negativeness of the) deficit, with one- and two-quarter lags in a highly significant fashion. Finally, it is worth noting that the finding of the budget deficit affecting stock returns *may be* construed as evidence of market inefficiency.

What could possibly account for this finding? First of all, it is rather surprising that the financial/economic literature, as mentioned in the previous section, has not dealt much with the impact of fiscal deficits on the stock market despite the evidence that fiscal deficits lead to 'crowding-out' of real investment and higher interest rates, which would lower stock returns. Perhaps market participants are not aware of the full impacts of budget deficits and, as such, they do not consider it a relevant or fundamental macro variable for pricing/valuing stocks. Alternatively, they may recognize the full impact of deficits but find it rather marginal (or unprofitable) to act upon this information (see Darrat, 1994, for further discussion on this).

Another explanation could be offered by tying the public's perception of the role of deficits on stock prices to the well-known Ricardian Equivalence Proposition, put forth by Barro (1974). Recall that this proposition states that rational individuals anticipate future tax liabilities, implied by current and expected deficits, and thus fully discount them currently. Consequently, they should not rebalance (or substitute assets in) their portfolios since any future government debt would be canceled out by future (increases in) taxation which suggests that government financing decisions should have no impact on stock (or asset) values. Perhaps, our finding that only two deficit lags are statistically significant (and rather marginally) in the stock returns equation, while the other one is not, may imply a violation of the Ricardian Equivalence Proposition. Nonetheless, this issue will be further investigated in the next section.

Finally, regarding the short-run linkages involving the money supply with the other two variables, we can see that changes in the either the deficit or stock returns exert no influence on the money supply. Also, past changes in the money supply have no impact on stock returns, a finding which suggests stock market efficiency with respect to monetary policy. In other words, it appears that participants in the U.S. market have incorporated all information pertaining to future Federal Reserve policy moves.

Table 3 depicts the variance decomposition results for each variable. The results for the deficit indicate that although changes in money supply account for a very small and unchanging amount over time, stock returns account for a larger and increasing amount over time that dies off extremely slowly (in fact, it takes more that three years to vanish). The declining amount of variance in the deficit is due to own innovations. The variance decomposition results for the stock returns show that the explanatory portion attributable to the deficit increases initially but declines sharply after the third quarter. The portion of the error variance attributable to the money supply shows that money supply affects stock returns in a persistent manner after three quarters. Finally, money supply seems to account for most of its own variation, while stock returns are seen to explain a small but increasing portion (less than 2%) of it, the deficit seems to account for a greater and increasing portion in its error forecast. However, the deficit's influence is initially negligible and it accounts for a large and rapidly increasing portion of the money supply's error forecast variance which extends well beyond three years.

Figure 1 displays the impulse response graphs for the three variables for up to 24 quarters (six years). From the first graph it is evident that both the stock returns and the money supply exert a mild, albeit persistent, influence on the deficit which lasts for up to a year. A more interesting pattern emerges for the impulse response graph for the stock returns (the second graph). Specifically, the effect of deficits on stock returns surfaces, initially, as positive and significant but after two quarters it becomes negative and remains negative for two more quarters before it turns positive and dissipates after a year and a half. This behavior is consistent with the theoretically expected negative relationship between stock returns and the deficit, which implies market inefficiency. Since the negative impact of the deficit on the stock market does not surface immediately but with a significant lag, it is quite plausible (to assume) that market participants overlook it or ignore it because they may believe that some other factors (including monetary policy) has raised the interest rate. Note also that announcements regarding upcoming monetary moves are much more (frequently) publicized than fiscal moves including increases or decreases in the deficit. Such announcements have only recently (i.e., the last few years) begun to be made publicly by the Fed's current Chairman Alan Greenspan.

Notable is also the behavior of the stock returns to changes in the money supply (see third graph), which respond with a negative (two-quarter) lag to the monetary change, which remains negative and persistent (for up to four years or 16 quarters as shown in the graph). This lagged (and negative) response of the stock returns is consistent with the general portfolio equilibrium approach explained above (see Hamburger and Kochin, 1972; Homa and Jaffee, 1971; and Rozeff, 1974). However, the negative and persistent response of the stock returns cannot be easily explained as other factors may be at play here such as an interest rate effect or a corporate earnings effect (both of which produce a positive sign). However, it may be explained by a risk premium effect or an inflation effect both of which produce a negative sign. We will, however, explicitly model some of these factors in subsequent sections.

Finally, the graph for the money supply (the third one) indicates mild and non-turbulent behaviors for all three variables. This means that there are no abrupt reactions to innovations to and from a variable. Alternatively, it might be interpreted that the money supply does not significantly and unpredictably affect the deficit (which, incidentally, remains negative for more than three years to shocks coming from the money supply) or the behavior of stock prices and perhaps another monetary aggregate like the federal funds rate may be important. Better yet, it might be quite plausible to assume that the money supply impacts the stock market *indirectly* via its effects on the risk premium (magnitude not explicitly modeled here) or inflation (to be examined later). Nonetheless, it is well-known, after all, that the money supply or aggregates such as M1, M2 and so on, as meaningful and relevant measures of monetary policy, have broken down in the 1970s in favor of the federal funds rate henceforth.

In view of the conclusions reached earlier that the money supply may not be a good indicator of the conduct of monetary policy, Table 4 exhibits the variance decomposition results for the stock returns, budget deficit, and the federal funds rate (we omitted the VAR results for the sake of space preservation but they are available upon request). In this specification (but not in the one with the money supply), we encountered a variable ordering problem. Therefore, we employed the Granger causality test to determine the order of the variables. It was revealed (these results are also available upon request) that stock returns Granger-cause the budget deficit which, in turn, causes the federal funds rate. So, the variable order will be as follows: stock returns, deficit, and federal funds rate. From the table, we observe that stock returns are rather 'exogenous' in the sense that shocks from neither the deficit nor the fed funds rate exert any significant impact on them. Almost all of its variation (98% to 99%) emanates from own innovations and only 1% from innovations in the deficit.

The deficit's variance decomposition indicates a greater explanation from stock prices (about 18%) and a growing one from the federal funds rate (up to 6% after three years or beyond). Finally, the fed funds rate's decomposition results suggest an increasing fraction (more than 7%) from the deficit and a decreasing one (from 7% to 5% or lower) from the stock returns account for its variability. These results imply that unexpected shocks from growing deficits seem to be more important than shocks from the stock market. The impulse response graphs in Figure 2 highlight the following reactions by each variable. First, a shock to the deficit (that is, a reduction in the deficit, as measured here) has a positive impact on stock returns, initially, but a negative and a growing one thereafter (that is, after about a year and a half). Additionally, fed funds rate innovations do not impact stock returns at first but only with a significant lag of eight quarters and then positively. Second, the deficit responds in a positive and weakening manner to innovations from stock returns, and its responses become negative after five years, and in a negative and strengthening manner to innovations from the fed funds rate. And third, the fed funds rate positively reacts to shocks from the deficit but negatively, initially, and positively after three years to shocks from the stock returns.

The response of the fed funds rate to fiscal shocks deserves some attention. Recall that in Figure 1 we found a positive (and perhaps explosive) behavior of the money supply measure of monetary policy and such a positive (but less expansive) behavior was also found with the fed funds rate. Although one can rationalize the second result, since higher deficits result in increases in interest rates, the first is not easy to explain (with the current model specification). One thing that we can possibly say is that we observe a violation of the Ricardian Equivalence Proposition which postulates no relationship between the interest rate and the deficit(s). However, perhaps one needs to disaggregate fiscal policy (and hence, shocks) into its components (like taxes and expenditures) and see which one exerts such an impact on the interest rate. We plan to do these in the next section.

Finally, statistically speaking, the atheoretical nature of the VAR and the large number of parameters involved makes the estimated model (and its coefficients) difficult to interpret, as mentioned above. For that reason, we performed some block significance tests (or pairwise Granger causality tests) and the results from these tests are displayed in Table 5. In general, these results imply general significance of the tested variables (with the possible exception of the money supply in the stock prices equation in the first VAR specification, where the χ^2 statistic (0.23027) is very low). The test statistic (*All*) in the last row of each tested equation tests the joint significance of all other lagged endogenous variables in that equation and its values always imply statistical significance overall. Note that the second set of these tests refers to the VAR specification with the deficit, stock prices and fed funds rate.

IV. Additional evidence on the deficits - stock prices linkage

In this section we will use different measures of fiscal policy and market returns as well as include inflation in the VAR specifications. Specifically, we will decompose the fiscal measure into taxes (net of transfers) received by the government and general government expenditures (also net of transfers). Both variables will be expressed as percentages of GDP. The first variable can be considered as an aggregate tax rate imposed by the government on national output. Theoretically, one should expect a negative sign between taxes and stock prices (or returns) since higher taxes present a disincentive to invest (see, for instance, Blanchard and Perotti, 1999). The second variable represents the total government purchases and captures the government's demand on the national output. A priori, we should expect a positive sign for this variable as (certain categories of) governments spending may stimulate the economy and thus the stock market via advances in productivity growth (see, Aschauer, 1989).

Furthermore, we will use alternative measures of market returns such as market excess returns and corporate profits (before and after taxes) along with (either one of) the above fiscal measures with the fed funds rate. Finally, we propose to include the rate of inflation in the model specifications (in subsection 3 below) for two reasons. First, to capture the conventional wisdom that stocks provide a hedge against inflation or that, following Fisher's theory, nominal equity returns should be positively related to inflation despite much evidence to the contrary (see, for instance, Fama and Schwert, 1977, Geske and Roll, 1983, to name a few). And second because financial assets are not assumed to be neutral with respect to inflation (see Chen, Roll and Cox, 1986).

1. Disaggregated Deficit Measures

Preliminary statistical investigation showed that taxes (as share of GDP), the federal funds rate, and the (log of) stock prices are cointegrated. As a result, a vector error-correction model (VECM) must be estimated in order to capture the long run relationships among the three variables. Such a model is given below (which is an augmentation/modification of the basic VAR model given in subsection 3 of section II given by equations 1a to 1c):

$$\Delta BDY_t = \alpha_1 + \gamma_1\, \varepsilon_{t-1} + \sum_{i=1}^{n} \lambda_{1,i}\, \Delta BDY_{t-i} + \sum_{i=1}^{n} \kappa_{1,i}\, \Delta SP_{t-i} + \sum_{i=1}^{n} \nu_{1,i}\, \Delta FFR_{t-i} + \varepsilon_{1,t} \quad (3a)$$

$$\Delta SP_t = \alpha_2 + \gamma_2\, \varepsilon_{t-1} + \sum_{i=1}^{n} \lambda_{2,i}\, \Delta BDY_{t-i} + \sum_{i=1}^{n} \kappa_{2,i}\, \Delta SP_{t-i} + \sum_{i=1}^{n} \nu_{2,i}\, \Delta FFR_{t-i} + \varepsilon_{2,t} \quad (3b)$$

$$\Delta FFR_t = \alpha_3 + \gamma_3\, \varepsilon_{t-1} + \sum_{i=1}^{n} \lambda_{3,i}\, \Delta BDY_{t-i} + \sum_{i=1}^{n} \kappa_{3,i}\, \Delta SP_{t-i} + \sum_{i=1}^{n} \nu_{3,i}\, \Delta FFR_{t-i} + \varepsilon_{3,t} \quad (3c)$$

where Δ denotes change in the variable, and γ_1 is the coefficient of the (lagged) error-correction term, ε_{t-1}, which reflects the long-run equilibrium situation among the three variables. The theoretically expected sign of that term is negative, which implies that any deviations form a variable will be corrected or reversed in the future.

Table 6 contains the VECM estimates, in panel A, and the variance decompositions, in panel B. From the estimates, we see that the error-correction terms for the (change in the) stock prices and the (change in the) fed funds rate are negative and statistically significant. This means that any deviations of these variables from the average (or norm) will be reversed in the future to restore equilibrium. Another noteworthy observation from the estimates is the general absence of short-run linkages among the three variables. We see such linkages only in the cases of the taxes, TY, and the fed funds rate, FFR, equations. Specifically, current tax receipts are negatively affected by two-quarter lags of stock prices and one-quarter lag of the fed funds rate. By contrast, the fed funds rate is negatively and strongly affected by lagged tax receipts and by last quarter's movement in the stock market. These results merit some explanation. An increase in tax receipts by the government, *ceteris paribus*, implies a lower (future) government borrowing (or less debt) and thus a lower interest rate. Alternatively, stock market declines mean lower corporate profits and lower tax revenues, and this might necessitate higher government borrowing which would place an upward pressure on the interest rate. In either case, this would constitute a violation of the Ricardian Equivalence Proposition again.

The variance decomposition results (in panel B) are more informative, however. For instance, tax receipts are seen to account for a high and growing portion (more than 27%) of the stock prices error forecast variance and an average of 9% of the fed funds rate. The fed funds rate represents a smaller but growing percentage (about 7%) of stock prices' decomposition and a small portion of the taxes' decomposition (just over 2% and declining). Finally, stock prices explain a very large portion of the fed funds rate's variance decomposition (ranging from 11% to 24% and growing) but almost nothing of the taxes' decomposition. These findings are strongly corroborated by the impulse response graphs in Figure 3. Shocks from the stock market and the fed funds rate negatively (and similarly) impact taxes during the first three years before they stabilize. Shocks from taxes and the fed funds rate elicit positive and negative responses by the stock prices, respectively, and these responses appear to be rather persistent but ‘well-behaved’ (that is, not turbulent). The behavior of the stock market to unanticipated tax revenues changes is counterintuitive and perhaps this works through other concurrent changes in the tax code and/or the market (like reductions in the marginal tax rates and a booming stock market). Regardless, we will investigate this issue in the next section.

2. Alternative Measures of Market Returns

We begin this subsection with the use of before- and after-tax corporate profits, and then with excess market returns along with the above two measures of the deficit and the federal funds rate. Preliminary statistical investigation indicated no cointegration among any group of these magnitudes, as they were included in each specification and, at times, the variable ordering issues were resolved via the use of Granger-causality tests. Finally, we chose to omit the model’s estimated parameters for the sake of space preservation (but these are available upon request).

Table 7 shows the variance decomposition results from the VAR model with before-tax corporate profits (BTPROF), taxes (as % of GDP), and the federal funds rate. The results suggest that the fed funds rate accounts for a significant and growing percentage (13% and up) of the variability in the taxes but taxes account for a small (less than 9%) fraction of the error forecast variance of the fed funds rate. Also, we observe significant and increasing portion (13% and up) of the variability in the profits measure by the taxes but none form the fed funds rate. By contrast, profits play a role in explaining the error variability in the fed funds rate (ranging from 2 to 4%) second to the taxes (which fluctuate widely from 2 to 12% over time). The impulse response graphs, in Figure 4, illustrate that shocks to corporate profits and the fed funds rate elicit negative responses from the taxes, a finding that economically makes sense. An unexpected increase, for instance, in the (short-term) interest rate (or the discount rate) lowers expected returns and thus profits which, in turn, imply lower tax receipts from the government. A similar response is seen from the second graph in the figure. There, the reaction to an (unanticipated) increase in taxes results in lower corporate profits but in no effect on the fed funds rate (seen as remaining flat in the graph). Finally, the third graph in Figure 4 indicates a negative, at first, response of the fed funds rate to innovations emanating from taxes, but it turns positive after six quarters. This suggests that higher tax receipts, lower the government's demand for funds in the short-run (or that the government incurs less debt) and thus the short-term interest rate. However, in the long run the interest rate is raised either due to more government borrowing requirements or to a lower economic activity which generates less tax revenues.

Although very similar results were obtained using the after-tax corporate profits measure (and so we are not presenting them), we need to mention that the share of the taxes in the variance decomposition of the after-tax corporate profits is much higher (reaching more than 13%) and the fed funds rate's share of the taxes' variance decomposition is lower when the before-tax profit measure was used. Finally, the impulse response graphs show a similar pattern as with the before-tax corporate profit measure.

Table 8 exhibits the variance decomposition results among the market excess returns (EMR), federal funds rate, and taxes. We observe a significant and growing fraction of the taxes' decomposition to be accounted for by the excess returns and the fed funds rate. By contrast, taxes account for a constant and declining portion of the excess returns' decomposition (around 7%) and an increasing, initially, but a rapidly declining portion of the fed funds rate's decomposition (starting from 2%, reaching a high of almost 10% and then declining to 3%). Notable is also the insignificant influence of the fed funds rate on the excess market returns (which amounts to a mere 1 percentage point and slowly increasing). It might be worthy to mention that we performed the same analysis substituting taxes with government purchases and by including both fiscal policy items abut the results did not change substantially the conclusions reached thus far.

Figure 5 depicts the impulse response graphs for the three magnitudes. Noteworthy are the responses of the excess returns to shocks from the other two variables. We see that the turbulence in the returns generated from the taxes and the fed funds rate subsides after two years after some initial ups and downs. We also notice a negative response of the funds rate to innovations from taxes a result, again, consistent with our previous findings when other measures of the deficit were used. Finally, the negative reactions of the taxes to shocks from the other two variables is consistent with the earlier findings and can be rationalized on the grounds that lower market returns decrease tax revenues and/or increases in the interest rate (or the discount rate) lower expected market returns and lower tax receipts in the future.

3. The Impact of Inflation

As mentioned in the second section, the conventional wisdom is that stocks should represent a hedge against inflation and thus a positive relationship between nominal stock returns and inflation should exist. However, evidence provided by Fama and Schwert (1977), Geske and Roll (1983), McCarthy et *al*. (1990), and Laopodis (2006) to name a few, suggests a negative relationship between the two. Although, subsequent research by James et al. (1985) and Fama (1990) renders this negative relationship as 'spurious' rather than causative, further research by Park (1997), Siklos and Kwok (1999) and Laopodis (2006) does not support this argument. As a result, the relationship between stock returns and inflation continues to be an empirical issue.

We experimented with the budget deficit, taxes and government expenditures (all as % of GDP) with the other three variables (i.e., stock prices, inflation rate, and fed funds rate) but did not see great differences in the way inflation affects the stock market or the two disaggregated deficit measures and vice versa. The same conclusion generally applies with the uses of various market measures (that is, nominal returns and excess returns). Consequently, we will report the results with the taxes and the budget deficit variables and omit those with the government expenditures along with the other three variables. These results (for selected periods) are tabulated in panels A and B of Table 9. From panel A we see that all variables account for a significant portion of the variance decomposition of the stock prices with the greatest and growing portion attributed to inflation followed by the taxes. By contrast, much smaller portions of the variability in taxes are explained by the other three variables. When using the budget deficit measure (in panel B), as opposed to taxes, we observe an almost negligible fraction of the variability in the stock prices being measured by the deficit (as well as the federal funds rate) followed by inflation (which accounts for about 7% of it). By contrast, stock prices do account for a large portion (about 20%) of the variability in the deficit while the other two variables explain no more than 2 to 3 percent of it.

Figure 6 shows the impulse response graphs for the two sets of variables identified above in panels A and B, respectively. We clearly see form these graphs that the stock market reacts negatively to shocks from inflation and the federal funds rate but positively to changes in either the taxes or the deficit (as previously found). This finding again supports the additional evidence presented by Fama and Schwert (1977) and Schwert (1981) where they find that the stock market reacts negatively to (unexpected) CPI inflation. These authors conclude that such reactions can be interpreted as providing the market and the rational investor with useful information to more efficiently price equities. Finally, the differential responses of the taxes and the deficit to the other variables are again consistent with the findings in the previous sections. Additionally, for both magnitudes the impact of inflation appears more persistent than those of the fed funds rate (or the stock market).

V. Robustness Tests

In this section we will perform several additional tests to see if our above results remain robust (stable) in addition to the alternative specifications tried above. Because splitting the sample into subperiods would only leave us with a few observations, we reran the models for the entire period using dummy variables for each of the following events: the Reagan tax of 1981, the market crash of 1987, and the boom of the mid 1990s.

The Reagan Tax Act of 1981 did not have a perceptible effect on the stock market whether this variable was paired with the deficit, taxes, or expenditures (as shares of GDP) variables in the VAR model estimations and the dummy variable was insignificant. This finding is justified because at the same time that the marginal tax rates were reduced, the US economy experienced a boon in its stock market due to advances in technology and a sharp reduction in energy prices. As a result, tax revenues actually rose and the deficit was reduced. The same conclusion was reached with the inclusion of the dummy variable for the October 1987 market crash. The aftermath of the crash did not impact upon the deficit and there was no significant influence of the crash dummy on either the stock market (measured by prices or returns) or any component of the deficit.

Finally, the use of the dummy variable for the market boom of the mid to late 1990s revealed a positive and statistically significant coefficient for the dummy. Although the basic variance decomposition results were not significantly altered when we employed the three deficit measures, the impulse response graphs (in Figure 7) yielded the following conclusions (relative to Figure 2). First, the responses of each variable to shocks from the other variables have not been changed in nature. Second, the response of the deficit to innovations from the stock market surface as positive and more turbulent, initially, becoming negative after two years (relative to three and a half years as shown in Figure 2). Third, the reaction of the fed funds rate to shocks from the deficit become negative, at first, then positive and remained positive for up to three years before becoming negative thereafter. The same can be said to its response to shocks in the stock market which surfaces as swift(er) alternating between negative and positive values. Contrast these reactions of the fed funds rate to those which took much longer to materialize in this manner when the dummy variable was omitted in the specification that yielded the third graph in Figure 2.

Overall then, although the basic (nature of the) relationships among the variables has not been altered, the speed of adjustment (or response) of each of these variables to shocks from the other variables has been shortened. For example, the reaction of the stock market to shocks from the fed funds rate surfaces immediately (within a quarter) as negative, relative to a year's time as seen in Figure 2, and the impact of the deficit on the stock market (regardless of the measure) emerges as stronger than is evident in Figure 2. Therefore, we are very confident that the results from the earlier VAR/VEC specifications were adequate in capturing the complex dynamics among the stock market, fiscal and monetary policies for the 1960:I to 2004:IV period.

VI. Summary and Conclusions

This paper examined the dynamic linkages among the federal budget deficit, monetary policy and the stock market for the 1960 to 2004 period using quarterly data. The empirical results among the budget deficit (as % of GDP), stock prices and money supply magnitudes reveal reciprocal, short-run linkages between the first two but not with the money supply. The first finding suggests that deficits do matter for the stock market and imply a violation of the Ricardian Equivalence Proposition, which states that current government deficits become irrelevant for current portfolio substitution decisions by rational investors if they correctly anticipate increased future taxation. Upon replacing the money supply with the federal funds rate, in view of the relative exogeneity of the money supply as a measure of monetary policy, we see that higher deficits increase the short-term interest rate due to higher government borrowing, ceteris paribus.

Further analyses using decompositions of the deficit (into taxes and spending, both as fractions of GDP) show a higher sensitivity of the stock market to them and especially to taxes relative to spending and/or the general deficit measures. When employing variations of market returns such as before- and after-tax corporate profits and excess market returns, we observe several economically significant results. For instance, unexpected increases in the fed funds rate lower expected stock returns leading to lower corporate profits and, thus, ultimately lower corporate tax revenues. Finally, the explicit modeling of inflation along with the deficit, fed funds rate and stock prices indicates a negative response of the stock market to innovations in inflation a result taken to suggest that the stock market pays attention to inflation information before pricing assets.

Overall then, we conclude that U.S. federal deficits do matter for the U.S. stock market and, perhaps, becoming more important over time. It should not come as a surprise that the Fed's current chairman makes it a routine in his public speeches to include information and/or warnings on the growing size of the federal deficit and its potential financial implications. A useful exercise would be to see if deficits are becoming more and more important in the eyes of investors using different methodologies and additional data/variables. Moreover, that study could be extended to draw inferences about market efficiency with respect to government deficits and the further determination of a validation/ violation of the Ricardian Equivalence Proposition and its policy implications.

Table 1. Descriptive Statistics for Selected Variables

Statistics	BDY	FFR	SP	MS
Mean	-1.439850	6.194383	5.347671	14.32728
Median	-1.064185	5.526900	4.911772	14.52726
Maximum	2.264549	17.78690	7.312273	15.70545
Minimum	-4.518711	0.996700	3.980055	12.65204
Stand. Dev.	1.449810	3.319677	1.002052	0.916154
Skewness	-0.195349	1.073244	0.577798	-0.290738
Kurtosis	2.366522	4.428101	1.925605	1.749743
Jarque-Bera	4.154547	49.85162	18.67296	14.25942
Probability	0.125271	0.000000	0.000088	0.000801

Correlation Matrix

	BDY	FFR	SP	MS
BDY	1	-0.10815	-0.34078	-0.56851
FFR		1	-0.23288	0.05537
SP			1	0.90598

Granger Causality Results*

Null Hypothesis	Obs.	F-statistic	Probability
FFR does not Granger Cause BDY	172	0.50262	0.85295
BDY does not Granger Cause FFR		2.61057	0.01047
SP does not Granger Cause BDY	172	2.53110	0.01289
BDY does not Granger Cause SP		1.27064	0.26263
MS does not Granger Cause BDY	172	0.60941	0.76902
BDY does not Granger Cause MS		1.41524	0.19408
SP does not Granger Cause FFR	172	2.52846	0.01298
FFR does not Granger Cause SP		0.76215	0.63658
MS does not Granger Cause FFR	172	4.76084	3.0E-05
FFR does not Granger Cause MS		3.13684	0.00257
MS does not Granger Cause SP	172	1.79855	0.08119
SP does not Granger Cause MS		0.49747	0.85667

Notes: time period is 1960:1 – 2004:4; BDY is the budget deficit as % of GDP; SP is (the log of the) nominal stock prices; MS is the (log of the) money supply, and FFR the federal funds rate; * test was done with up to 8 lags (quarters).

Table 2. Vector Autoregression Estimates, 1960-2004

	ΔBDY	ΔMS	ΔSP
ΔBDY(-1)	-0.81441*	-0.02668	1.02663*
	(-2.47566)	(-1.01982)	(2.20147)
ΔBDY(-2)	0.27462*	-0.01789	-0.90086
	(2.09560)	(-1.01746)	(-1.45568)
ΔMS(-1)	0.03245	0.68707**	-0.42741
	(1.38243)	(6.11995)	(-1.37722)
ΔMS(-2)	-0.05696	0.30926*	0.34633
	(-1.32713)	(2.16281)	(1.23259)
ΔSP(-1)	0.03714*	-0.00552	0.01132*
	(2.22426)	(-0.10548)	(2.00657)
ΔSP(-2)	0.05220**	0.00775	-0.11240
	(2.79497)	(0.12866)	(-1.21022)
Constant	0.35291	0.05827	0.51865*
	(1.20510)	(0.22009)	(1.81867)
R-squared	0.14575	0.10957	0.39830
Adj. R-squared	0.10202	0.08943	0.37775
F-statistic	6.55933	2.45363	18.4271
Log likelihood	-171.131	-606.401	-186.686
FPE	1.47382		

Notes: *, ** mean statistically significant at the 5 and 1 percent levels, respectively; Δ means change in a variable; numbers in parentheses below estimates are t-ratios; negative numbers in parentheses next to variables denote a lag; FPE is the Final Prediction Error criterion.

Table 3. Variance Decompositions of Budget Deficit, Stock Returns and Money Supply Growth

Variance Decomposition of ΔBDY:

Period	Stand. Error	ΔBDY	ΔSP	ΔMS
2	0.578947	98.45590	1.213531	0.330565
3	0.744451	95.67574	4.084184	0.240079
4	0.853918	94.26836	5.453285	0.278354
5	0.942988	93.23807	6.434075	0.327856
6	1.006390	92.33991	7.272972	0.387118
7	1.054850	91.58101	7.989648	0.429339
8	1.090329	90.94253	8.593468	0.464000
9	1.117035	90.38788	9.124701	0.487416
10	1.136987	89.89594	9.601834	0.502228
11	1.152109	89.45430	10.03578	0.509919
12	1.163600	89.05307	10.43412	0.512805

Variance Decomposition of ΔSP:

Period	Stand. Error	ΔBDY	ΔSP	ΔMS
2	0.115658	7.507565	92.48983	0.002606
3	0.138158	8.952434	90.38883	0.658737
4	0.157959	8.701301	89.88036	1.418341
5	0.175421	8.012825	89.98413	2.003041
6	0.190226	7.299538	90.17286	2.527604
7	0.203107	6.625993	90.37653	2.997473
8	0.214615	6.027774	90.57910	3.393130
9	0.225001	5.517881	90.75600	3.726115
10	0.234460	5.090310	90.89804	4.011651
11	0.243158	4.733293	91.00727	4.259439
12	0.251214	4.435235	91.08744	4.477324

Variance Decomposition of ΔMS:

Period	Stand. Error	ΔBDY	ΔSP	ΔMS
2	0.011925	1.254765	0.511220	98.23401
3	0.016604	1.330244	0.497162	98.17259
4	0.020814	1.019967	0.643815	98.33622
5	0.024660	0.728314	0.855002	98.41668
6	0.028197	0.663547	1.048767	98.28769
7	0.031510	0.947742	1.219274	97.83298
8	0.034672	1.622599	1.368048	97.00935
9	0.037735	2.656279	1.496874	95.84685
10	0.040733	3.984369	1.609343	94.40629
11	0.043685	5.526006	1.710807	92.76319
12	0.046603	7.203889	1.805958	90.99015

Table 4. Variance Decompositions of Stock Returns, Budget Deficit, and Federal Funds Rate

Variance Decomposition of ΔSP:

Period	Stand. Error	ΔSP	ΔBDY	ΔFFR
2	0.117422	99.06509	0.933090	0.001822
3	0.140066	98.59503	1.396660	0.008314
4	0.160054	98.65146	1.339700	0.008839
5	0.177418	98.82616	1.166619	0.007216
6	0.192137	98.99297	1.000783	0.006242
7	0.205066	99.10595	0.888410	0.005638
8	0.216669	99.13972	0.855218	0.005062
9	0.227181	99.08622	0.908374	0.005408
10	0.236829	98.94662	1.045121	0.008258
11	0.245794	98.72752	1.256721	0.015763
12	0.254204	98.43820	1.531228	0.030576

Variance Decomposition of ΔBDY:

Period	Stand. Error	ΔSP	ΔBDY	ΔFFR
2	0.571160	7.318310	92.68124	0.000453
3	0.730586	12.99188	86.99637	0.011754
4	0.836429	14.81888	85.13056	0.050557
5	0.924774	16.08667	83.65522	0.258105
6	0.991534	16.93640	82.41625	0.647353
7	1.044741	17.46595	81.33819	1.195852
8	1.086227	17.75518	80.32731	1.917513
9	1.119504	17.89601	79.30563	2.798361
10	1.146359	17.92083	78.25940	3.819769
11	1.168433	17.85797	77.18640	4.955626
12	1.186861	17.72946	76.09059	6.179946

Variance Decomposition of ΔFFR:

Period	Stand. Error	ΔSP	ΔBDY	ΔFFR
2	1.494608	7.528465	0.060879	92.41066
3	1.783158	7.870483	0.093973	92.03554
4	1.974128	7.253992	0.317816	92.42819
5	2.141458	6.677397	0.846218	92.47638
6	2.293548	6.182836	1.562256	92.25491
7	2.428109	5.713297	2.420605	91.86610
8	2.546720	5.288451	3.402848	91.30870
9	2.652297	4.918417	4.483967	90.59762
10	2.746896	4.601637	5.627099	89.77126
11	2.831820	4.333776	6.803116	88.86311
12	2.907999	4.109847	7.988678	87.90147

Table 5. Pairwise Granger causality tests for the VAR models

Block Exogeneity Test Results[1]

Dependent variable: ΔBDY

Exclude	Chi-sq	df	Prob.
MS	3.523989	3	0.2802
SP	10.49566	3	0.0148
All	14.98348	6	0.0204

Dependent variable: ΔMS

Exclude	Chi-sq	df	Prob.
BDY	10.17002	3	0.0172
SP	6.077791	3	0.1079
All	7.989391	6	0.2587

Dependent variable: ΔSP

Exclude	Chi-sq	df	Prob.
BDY	7.172276	3	0.0666
MS	0.230212	3	0.9895
All	9.573903	6	0.0722

Block Exogeneity Test Results[2]

Dependent variable: ΔBDY

Exclude	Chi-sq	df	Prob.
FFR	5.887491	3	0.1172
SP	13.11305	3	0.0044
All	16.43013	6	0.0116

Dependent variable: ΔFFR

Exclude	Chi-sq	df	Prob.
BDY	5.314496	3	0.1502
SP	8.231037	3	0.0415
All	15.93312	6	0.0141

Dependent variable: ΔSP

Exclude	Chi-sq	df	Prob.
BDY	7.196864	3	0.0659
FFR	8.230875	3	0.0415
All	9.891260	6	0.0562

Notes: [1] tests refer to the VAR system with the deficit, money supply, and stock returns equation; [2] refers to the VAR system with the deficit, federal funds rate, and stock returns equation; sample: 1960:1 - 2004:4; included observations: 177; Chi-square (χ^2) is a Wald statistic for the joint significance of each of the other lagged endogenous variables in that equation; the statistic in the last row of each test (All) is the χ^2 statistic for the joint significance of all other lagged endogenous variables in the equation; df denotes degrees of freedom.

Table 6. VECM estimates for taxes (as share of GDP), ΔTY, federal funds rate, ΔFFR, and stock returns, ΔSP

Panel A: Error-Correction Estimates

Error Correction:	ΔSP	ΔTY	ΔFFR
E-C term	-0.039280*	0.002355	-0.734274*
	[-2.85720]	[0.14041]	[-4.90768]
ΔSP(-1)	0.011687	0.006449	-2.259526*
	[0.15269]	[0.06907]	[-2.71251]
ΔSP(-2)	-0.127148	-0.204309*	0.271784
	[-1.65331]	[-2.17801]	[0.32473]
ΔSP(-3)	-0.065986	-0.108947	0.899104
	[-0.84017]	[-1.13725]	[1.05190]
ΔTY(-1)	0.063208	-0.029751	-3.107724*
	[0.91166]	[-0.35180]	[-4.11860]
ΔTY(-2)	0.106760	0.008666	-3.611542*
	[1.51605]	[0.10088]	[-4.71247]
ΔTY(-3)	-0.110678	-0.007828	-1.011290
	[-1.53271]	[-0.08887]	[-1.28683]
ΔFFR(-1)	-0.004047	-0.016658*	0.114306
	[-0.58590]	[-1.97708]	[1.52056]
ΔFFR(-2)	-0.002440	-0.006650	-0.253758*
	[-0.37291]	[-0.83322]	[-3.56364]
ΔFFR(-3)	-0.008764	-0.007242	0.065841
	[-1.37053]	[-0.92855]	[0.94611]
Constant	0.019657*	0.012202	0.070283
	[3.05266]	[1.55349]	[1.00291]
Diagnostic Statistics			
R-squared	0.239204	0.114657	0.336839
Adj. R-squared	0.187034	0.017970	0.296647
F-statistic	2.968303	1.40592	8.380824
Log likelihood	205.2072	170.2439	-214.9413
FPE	-1.268109		

Table 6. VECM estimates for taxes (as share of GDP), ΔTY, federal funds rate, ΔFFR, and stock returns, ΔSP (concl'd)

Panel B: Variance Decomposition Results

Variance Decomposition of ΔSP:

Period	Stand.Error	ΔSP	ΔTY	ΔFFR
2	0.110301	98.18933	1.567824	0.242851
3	0.133224	92.21338	6.850933	0.935688
4	0.151087	88.03601	9.073251	2.890743
5	0.167967	83.76152	11.99621	4.242263
6	0.184342	79.70902	15.35057	4.940413
7	0.199750	76.07060	18.39392	5.535479
8	0.214102	72.98176	20.85561	6.162631
9	0.227717	70.38499	22.92281	6.692206
10	0.240762	68.16286	24.74269	7.094450
11	0.253249	66.24661	26.32645	7.426945
12	0.265194	64.59936	27.67803	7.722612

Variance Decomposition of ΔTY:

Period	Stand.Error	ΔSP	ΔTY	ΔFFR
2	0.133483	0.039768	98.91187	1.048365
3	0.166010	0.277688	97.65846	2.063848
4	0.194289	0.670283	96.63466	2.695058
5	0.217227	0.802395	96.28442	2.913181
6	0.236347	0.849693	96.23508	2.915223
7	0.252162	0.863973	96.25829	2.877734
8	0.265101	0.851978	96.31070	2.837324
9	0.275956	0.821906	96.40205	2.776041
10	0.285269	0.784439	96.51500	2.700563
11	0.293365	0.747041	96.62889	2.624067
12	0.300502	0.712966	96.73613	2.550899

Variance Decomposition of ΔFFR:

Period	Stand.Error	ΔSP	ΔTY	ΔFFR
2	1.311268	11.58781	3.127922	85.28427
3	1.599644	14.47841	10.29456	75.22703
4	1.834198	13.52016	13.74760	72.73224
5	2.033016	12.95021	12.65048	74.39931
6	2.189409	13.65571	11.19604	75.14825
7	2.314245	15.17963	10.05203	74.76834
8	2.429415	16.94166	9.213671	73.84467
9	2.546844	18.76624	8.992026	72.24173
10	2.667660	20.67840	9.427112	69.89449
11	2.791779	22.59798	10.37401	67.02801
12	2.920588	24.38533	11.72708	63.88759

Notes: * denotes significance at the 5% level; t-ratios in parentheses; E-C denotes the error-correction tem, sample: 1960:1 – 2004:4.

Table 7. Variance decomposition results for before-tax corporate profits, BTPROF, taxes (as share of GDP), ΔTY, and federal funds rate, ΔFFR.

Period	Stand.Error	ΔTY	BTPROF	ΔFFR
Variance Decomposition of ΔTY:				
2	0.130606	99.51680	0.163481	0.319718
3	0.157732	99.18124	0.168181	0.650580
4	0.179633	98.51485	0.204266	1.280885
5	0.198486	97.42403	0.320633	2.255333
6	0.211645	95.05241	0.580821	4.366767
7	0.222298	93.02960	0.923301	6.047103
8	0.231954	91.11562	1.226309	7.658074
9	0.239440	88.90813	1.664389	9.427480
10	0.245198	86.85892	1.972300	11.16878
11	0.250028	85.00091	2.210899	12.78819
12	0.254319	83.29504	2.512080	14.19288
Variance Decomposition of BTPROF:				
Period	Stand.Error	ΔTY	BTPROF	ΔFFR
2	0.107713	0.316896	99.54693	0.136176
3	0.135131	1.070864	98.75332	0.175813
4	0.156354	1.742062	98.12605	0.131886
5	0.169362	1.534225	98.34871	0.117064
6	0.175869	1.613760	98.27332	0.112922
7	0.180339	1.859572	97.97853	0.161896
8	0.185090	2.207235	97.61652	0.176248
9	0.189926	2.642163	97.18563	0.172204
10	0.195976	3.345030	96.49255	0.162415
11	0.202949	3.892611	95.95586	0.151534
12	0.210158	4.326764	95.53186	0.141373
Variance Decomposition of ΔFFR:				
Period	Stand.Error	ΔTY	BTPROF	ΔFFR
2	1.277580	2.329516	4.411748	93.25874
3	1.543198	9.255391	5.668266	85.07634
4	1.822768	11.62405	5.639301	82.73665
5	2.051902	9.398495	5.493471	85.10803
6	2.300056	8.022492	5.047678	86.92983
7	2.517763	6.983107	4.478560	88.53833
8	2.678453	6.446561	4.042677	89.51076
9	2.824646	6.502326	3.681329	89.81635
10	2.955051	6.987569	3.443762	89.56867
11	3.065176	7.709557	3.273986	89.01646
12	3.158902	8.427015	3.133634	88.43935

Table 8. Variance decomposition results for excess market returns, EMR, taxes (as % of GDP), ΔTY, and federal funds rate, ΔFFR.

Variance Decomposition of TY:				
Period	Stand.Error	ΔTY	EMR	ΔFFR
2	0.132463	99.23662	0.026207	0.737177
3	0.163709	97.54556	0.608229	1.846212
4	0.191992	95.40025	1.562291	3.037462
5	0.220694	91.85538	3.382238	4.762386
6	0.244782	89.38894	4.529365	6.081698
7	0.265656	87.59708	5.588185	6.814740
8	0.284537	86.12243	6.552015	7.325554
9	0.301094	84.84928	7.415436	7.735283
10	0.316162	83.96603	8.037831	7.996136
11	0.330283	83.37454	8.479548	8.145911
12	0.343675	82.94790	8.808570	8.243532
Variance Decomposition of EMR:				
Period	Stand.Error	ΔTY	EMR	ΔFFR
2	8.069388	2.751767	97.01102	0.237216
3	8.310858	7.397991	92.37755	0.224461
4	8.350495	7.541412	91.82941	0.629178
5	8.370524	7.626087	91.39047	0.983441
6	8.389663	7.763233	91.25172	0.985045
7	8.401085	7.772922	91.21370	1.013376
8	8.410179	7.892737	91.04665	1.060616
9	8.416723	7.918021	90.93064	1.151341
10	8.423234	7.905840	90.79276	1.301400
11	8.430223	7.893075	90.64497	1.461952
12	8.437569	7.879339	90.49623	1.624433
Variance Decomposition of ΔFFR:				
Period	Stand. Error	ΔTY	EMR	ΔFFR
2	1.416200	2.354535	2.924379	94.72109
3	1.767952	7.793341	2.967163	89.23950
4	2.111555	9.849183	2.085052	88.06576
5	2.439756	7.935746	1.968535	90.09572
6	2.726235	6.652330	2.161715	91.18595
7	2.975997	5.923920	2.295750	91.78033
8	3.195911	5.266049	2.381277	92.35267
9	3.385654	4.721901	2.407159	92.87094
10	3.557614	4.298945	2.414666	93.28639
11	3.719454	3.956010	2.384435	93.65956
12	3.870896	3.675214	2.320803	94.00398

Table 9. Variance decomposition results for stock returns, ΔSP, taxes (as % of GDP), ΔTY, inflation, INF, and federal funds rate, ΔFFR.

Panel A: variance decomposition of ΔSP, ΔTY, INF, ΔFFR

Variance Decomposition of ΔSP:

Period	Stand. E.	ΔSP	ΔTY	INF	ΔFFR
2	0.101531	96.09687	1.831440	2.027349	0.044338
4	0.141499	74.68204	13.41450	11.83142	0.072039
6	0.171579	62.58260	19.91376	17.44386	0.059789
8	0.197723	54.30444	25.30905	20.30134	0.085169
10	0.222159	47.76371	30.44153	21.66891	0.125849
12	0.246163	42.13628	35.31830	22.39445	0.150965

Variance Decomposition of ΔTY:

Period	Stand. E.	ΔSP	ΔTY	INF	ΔFFR
2	0.131904	0.051298	98.72290	0.576782	0.649024
4	0.191098	0.843114	94.28508	3.363676	1.508130
6	0.229019	1.030981	91.83026	5.475122	1.663633
8	0.254207	1.022835	90.61956	6.641280	1.716329
10	0.273074	0.942577	89.84081	7.502596	1.714017
12	0.287942	0.859808	89.20682	8.231171	1.702197

Variance Decomposition of INF:

Period	Stand. E.	ΔSP	ΔTY	INF	ΔFFR
2	0.122053	0.553145	2.318208	95.43495	1.693693
4	0.168782	0.393333	4.912459	89.18766	5.506548
6	0.202536	1.257168	8.100725	84.47802	6.164083
8	0.231113	2.710817	12.37709	78.15675	6.755340
10	0.256416	4.543065	16.14836	72.51281	6.795765
12	0.279063	6.371722	19.62556	67.39662	6.606102

Variance Decomposition of ΔFFR:

Period	Stand. E.	ΔSP	ΔTY	INF	ΔFFR
2	1.077798	3.568245	2.361222	0.926677	93.14386
4	1.673928	2.792441	12.50681	25.86430	58.83645
6	2.006240	2.143594	9.133211	34.74283	53.98036
8	2.196491	2.753225	8.218519	38.99091	50.03735
10	2.343924	3.750139	9.339753	40.19495	46.71515
12	2.470131	5.028925	11.27387	40.25154	43.44567

Table 9. Variance decomposition results for stock returns, ΔSP, budget deficit (as % of GDP), ΔBDY, inflation, INF, and federal funds rate, ΔFFR (concl'd).

Panel B: variance decomposition of ΔSP, ΔBDY, INF, ΔFFR

Variance Decomposition of ΔSP:

Period	Stand. E.	ΔSP	ΔBDY	INF	Δ FFR
2	0.114923	97.56940	1.307098	1.101925	0.021580
4	0.159406	93.15971	1.590321	5.205953	0.044020
6	0.190399	92.56684	1.147792	6.214950	0.070419
8	0.214638	91.86276	0.976906	7.090027	0.070302
10	0.234715	91.25270	1.098367	7.588220	0.060709
12	0.252221	90.64737	1.442684	7.853525	0.056417

Variance Decomposition of ΔBDY:

Period	Stand. E.	ΔSP	ΔBDY	INF	ΔFFR
2	0.571525	9.376804	90.57916	0.007238	0.036793
4	0.842857	17.10778	82.57077	0.222836	0.098605
6	1.007364	18.91121	80.26689	0.161188	0.660706
8	1.107179	19.16785	78.98724	0.271008	1.573911
10	1.165807	18.75511	77.89591	0.670249	2.678733
12	1.200923	18.11643	76.73726	1.368251	3.778051

Variance Decomposition of ΔINF:

Period	Stand. E.	ΔSP	ΔBDY	INF	ΔFFR
2	0.133622	4.902225	4.303014	89.63407	1.160686
4	0.191805	8.405965	8.964965	78.93727	3.691796
6	0.237037	9.142946	9.725822	77.20259	3.928637
8	0.268928	9.192692	10.17008	76.59977	4.037456
10	0.292685	8.857733	10.20119	76.90977	4.031307
12	0.310774	8.387298	10.09131	77.50200	4.019391

Variance Decomposition of ΔFFR:

Period	Stand. E.	ΔSP	ΔBDY	INF	Δ FFR
2	1.104255	2.786574	2.352718	1.664878	93.19583
4	1.675174	1.599310	1.953363	36.87767	59.56966
6	2.036080	2.185349	3.459067	44.32016	50.03542
8	2.315219	3.434086	5.422759	48.60220	42.54096
10	2.529995	4.539986	7.486198	50.64790	37.32592
12	2.691948	5.267258	9.027240	51.98655	33.71895

Figure 1. Impulse Response Graphs: Budget Deficit (as % of GDP), BDY, Stock Returns, SP, and Money Growth, MS

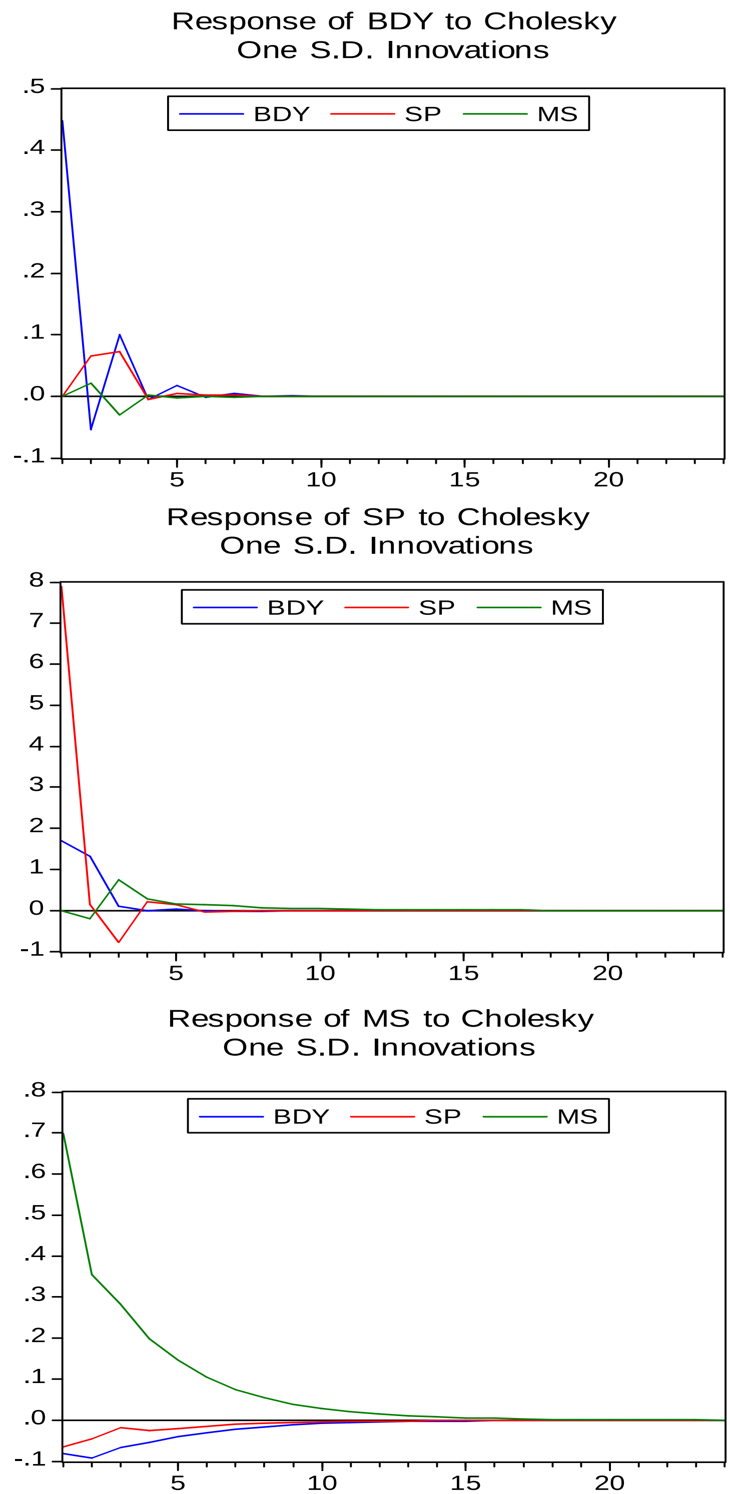


Figure 2. Impulse Response Graphs: Budget Deficit, Stock Prices, and Federal Funds Rate

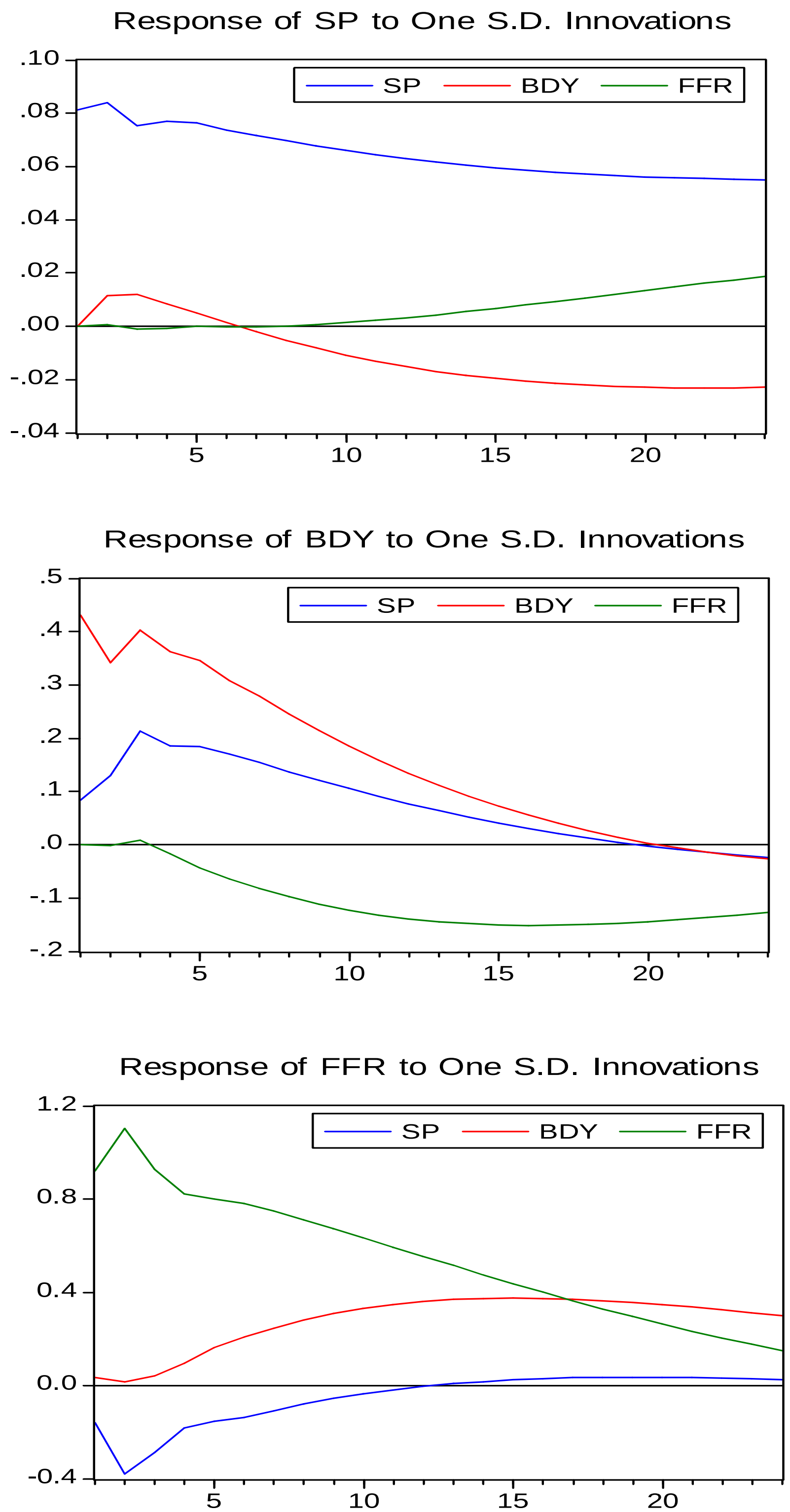


Figure 3. Impulse Response Graphs, Stock Returns, SP, Tax Receipts (as % of GDP), TY, and Federal Funds Rate, FFR

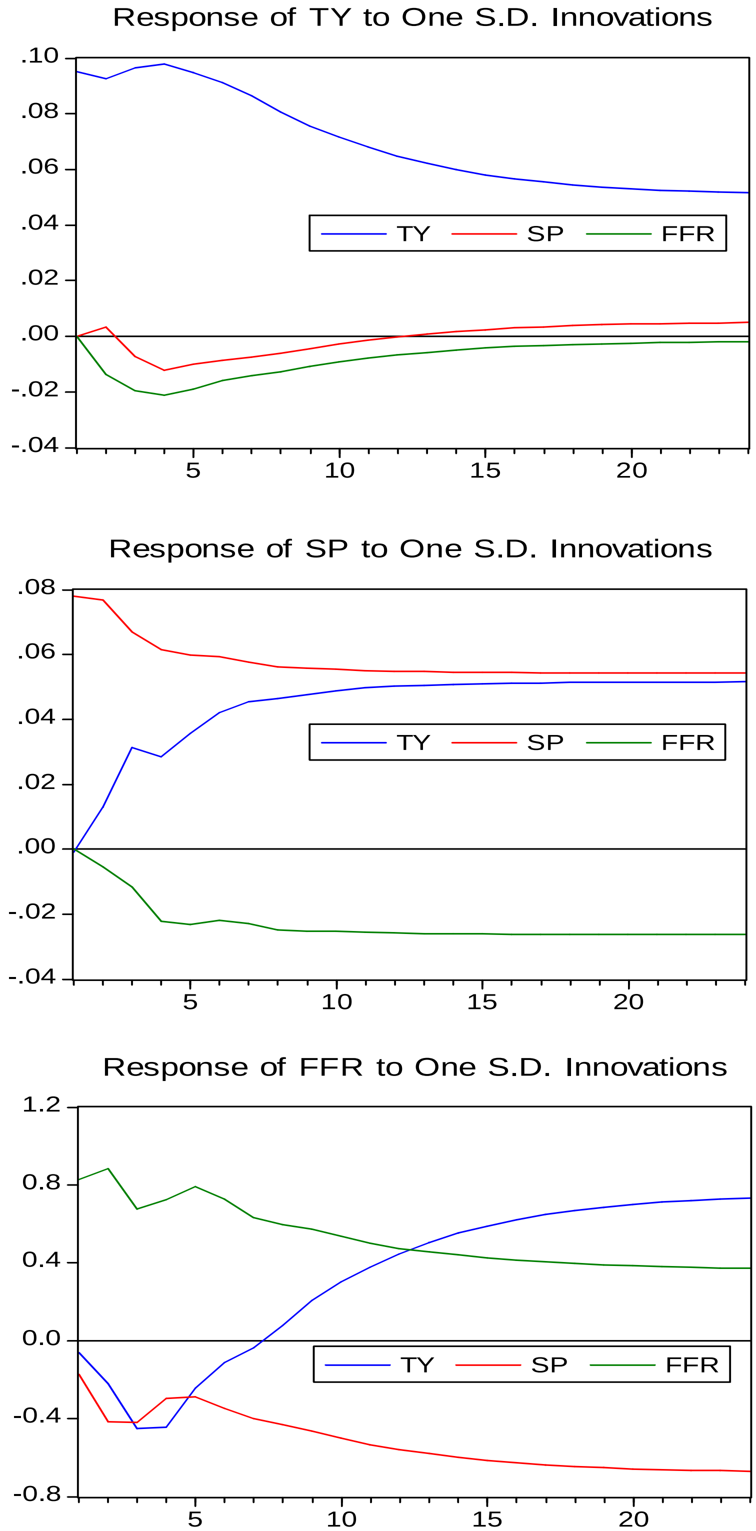


Figure 4. Impulse Response Graphs, Before-Tax Corporate Profits, BTPROF, Taxes (as % of GDP), TY, and Federal Funds Rate, FFR

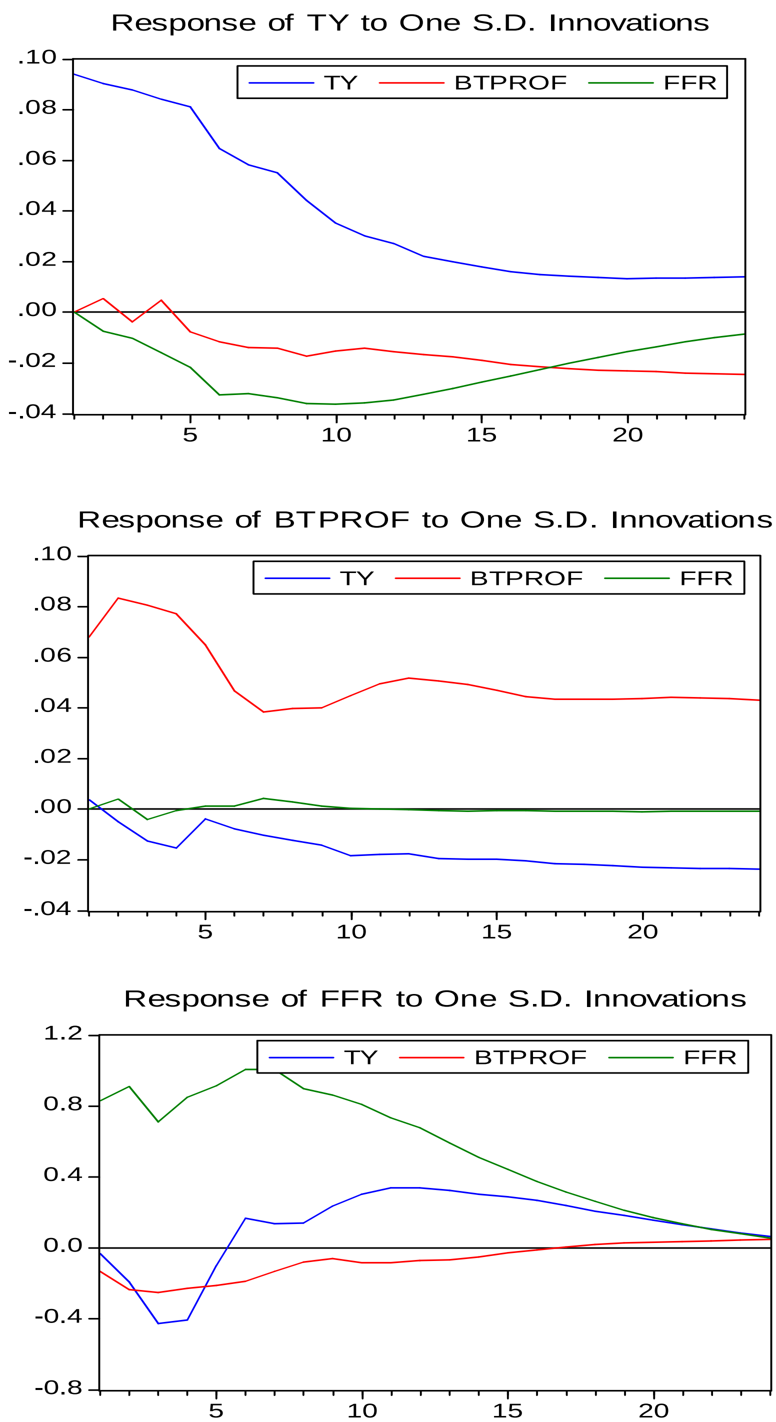


Figure 5. Impulse Response Graphs, Excess Market Returns, EMR, Taxes (as % of GDP), TY, and Federal Funds Rate, FFR

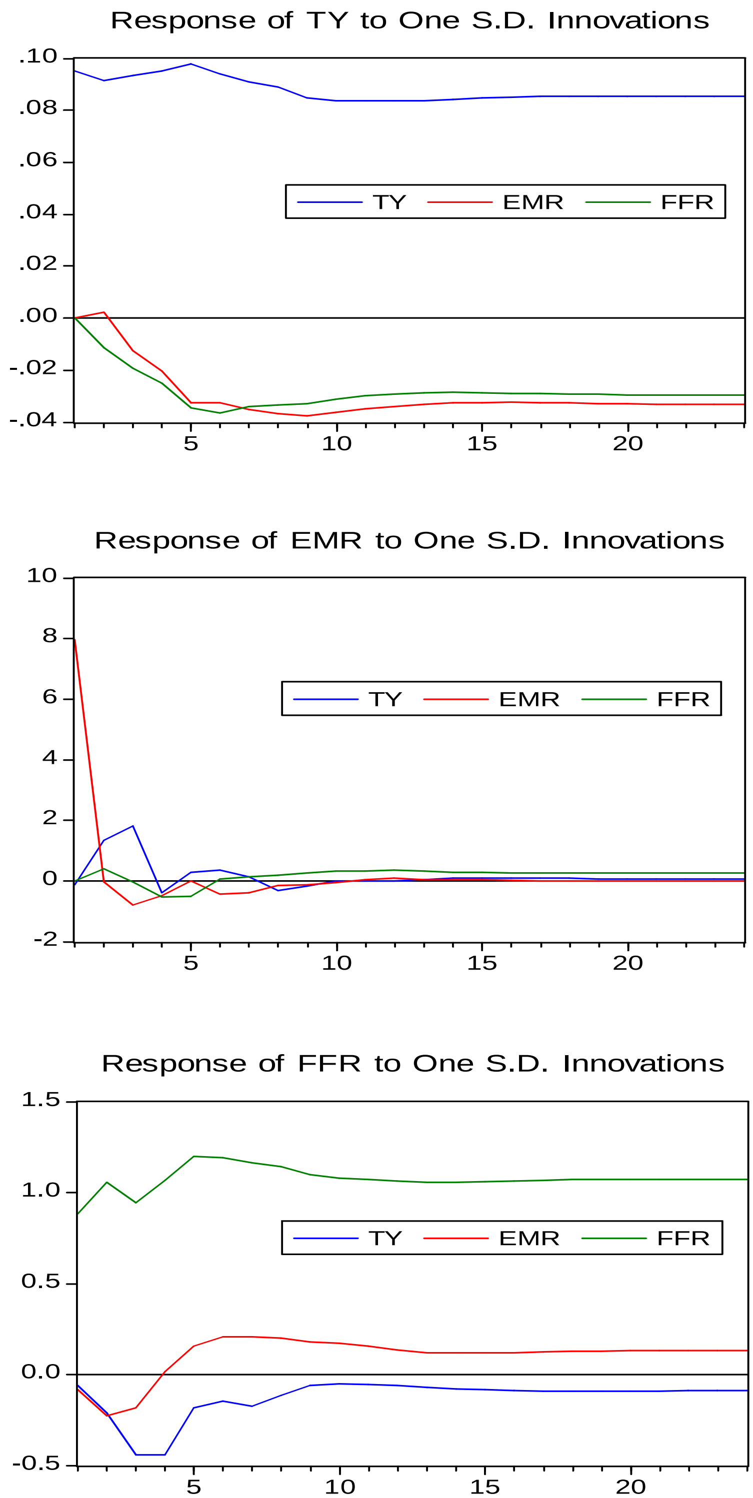


Figure 6. Impulse Response Graphs, Stock Prices, SP, Taxes (as % of GDP), TY, Budget Deficit (as % of GDP), BDY, Inflation, INF, and Federal Funds Rate, FFR

Panel A: SP, TY, INF, FFR

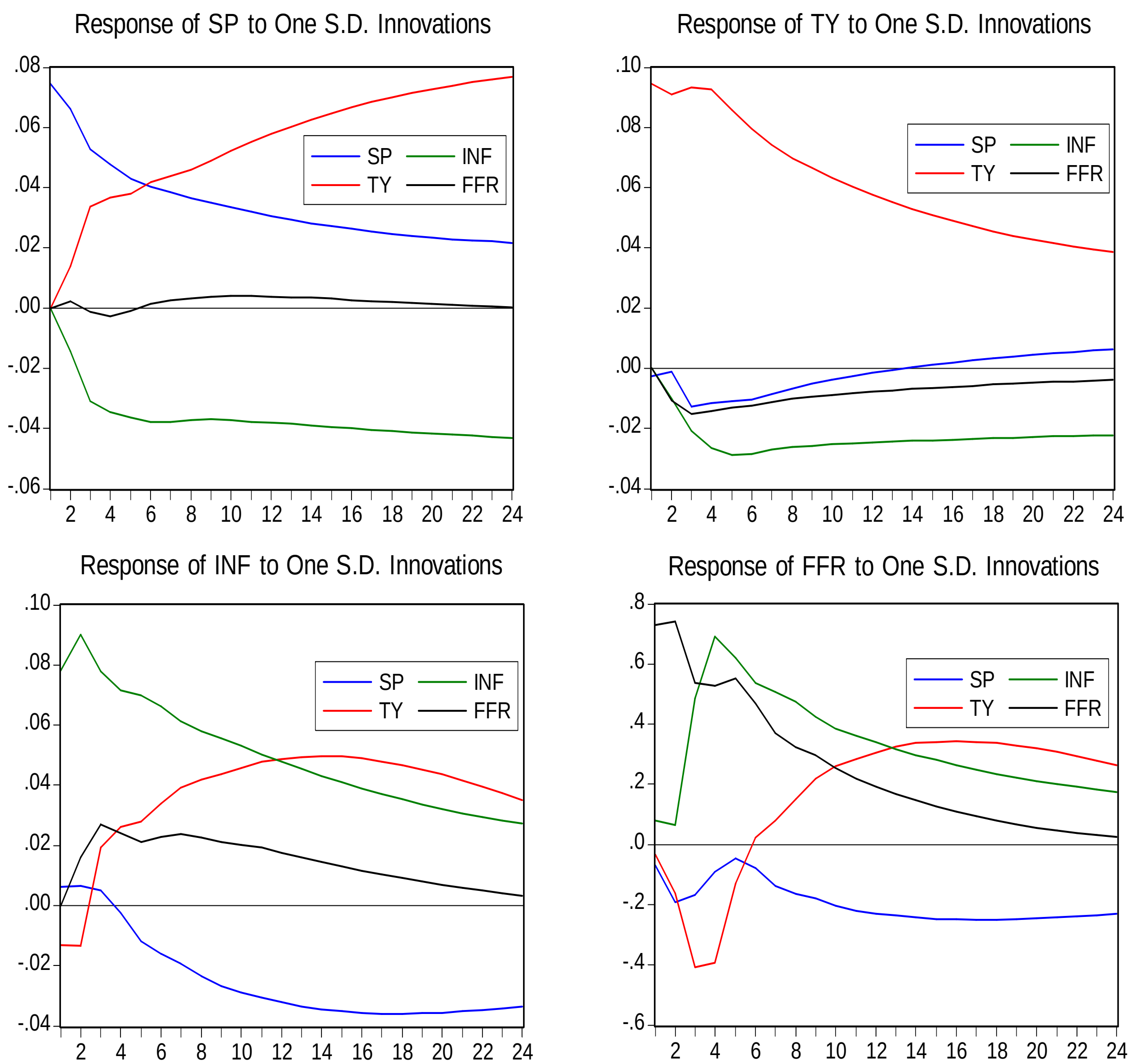


Figure 6. Impulse Response Graphs, Stock Prices, SP, Taxes (as % of GDP), TY, Budget Deficit (as % of GDP), BDY, Inflation, INF, and Federal Funds Rate, FFR, (concl'd)

Panel B: SP, BDY, INF, FFR

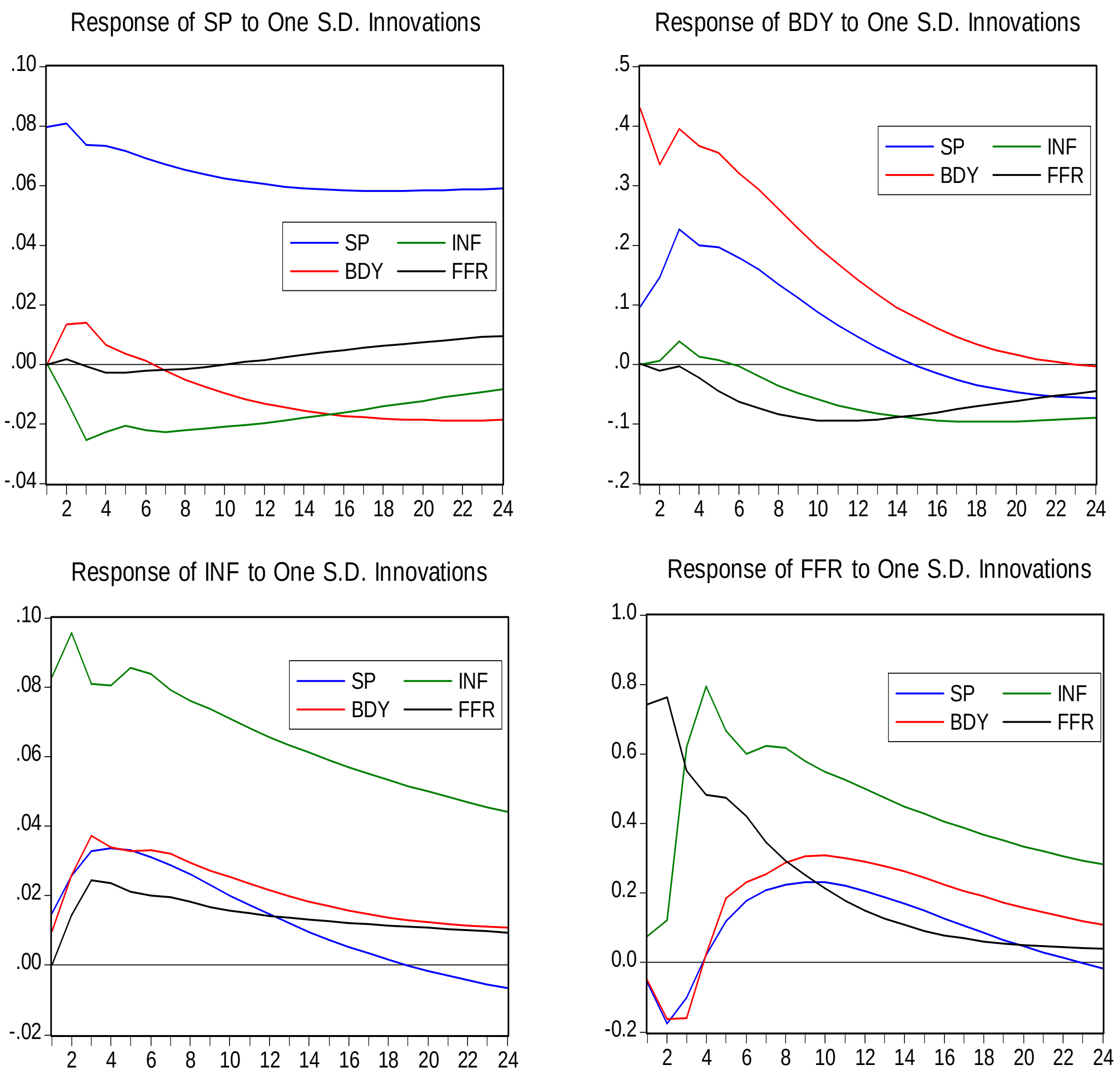
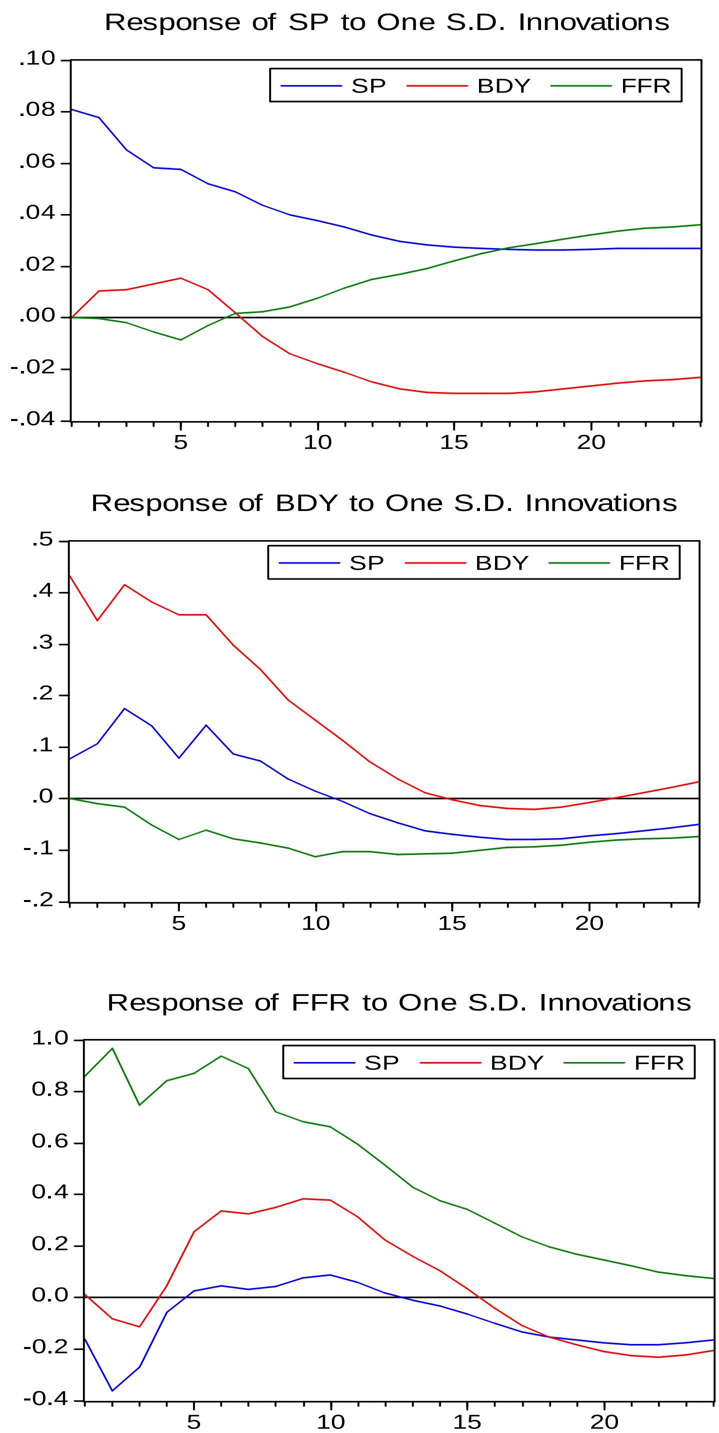


Figure 7. Impulse Response Graphs, Stock Prices, SP, Budget Deficit (as % of GDP), BDY, and Federal Funds Rate, FFR*



* using a dummy variable for the mid to late 1990s market boom years

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