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On Stock Market Returns and Monetary Policy

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by

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ABSTRACT

Boudoukh, Richardson, and Whitelaw (BRW) presented theoretical and empirical evidence explaining the expected inflation/stock return correlation. In concluding they stated that whether monetary policy has real effects is an open question. This paper addresses this question by examining how BRW's industry stock return data respond to monetary policy shocks. Monetary policy is measured by innovations in the federal funds rate and nonborrowed reserves, by narrative indicators, and by an event study of Federal Reserve policy changes. In every case the evidence indicates that expansionary policy increases *ex-post* stock returns. Results from estimating a multi-factor model also indicate that exposure to monetary policy increases an asset's *ex-ante* return.

IN AN INGENIOUS PAPER, Boudoukh, Richardson, and Whitelaw (1994) investigated the cross-sectional relation between expected inflation and industry stock returns. They described a money-neutral model in which a stock's expected inflation beta should depend positively on the correlation between the stock's expected dividend growth and expected inflation ($\rho_{g\pi}$). Building on Fama's (1981) "proxy" hypothesis, they argued that there is a negative relationship between $\rho_{g\pi}$ and the degree of cyclicality of an industry. Cyclicality was measured by the correlation between industry output growth and aggregate output growth (the industry's output beta). Consistent with their theory, they found that there is a clear negative relationship between a stock's expected inflation beta and the corresponding industry's output beta. In their conclusion they stated that whether monetary policy affects the real economy, and whether its effects are quantitatively important, remain open questions.

This paper addresses these questions by examining the effects of monetary policy innovations on the industry stock return data used by Boudoukh, Richardson, and Whitelaw (BRW). Theory posits that stock prices equal the expected present value of future net cash flows. Thus evidence that positive monetary shocks increase industry stock returns indicates that expansionary monetary policy exerts real effects by increasing future cash flows or by decreasing the discount factors at which those cash flows are capitalized.

To examine the relationship between monetary policy and stock returns a variety of empirical techniques are employed. Impulse-response functions and variance decompositions from a vector autoregression indicate that there is a large and statistically significant relationship between either negative shocks to the federal funds rate or positive shocks to nonborrowed reserves and subsequent increases in industry stock returns. Generalized method of moments estimation reveals that narrative evidence of a monetary expansion is also strongly correlated with increases in stock returns. An event study of changes by the Federal Reserve in its federal funds rate target provides additional evidence that a monetary expansion increases stock returns. Finally nonlinear seemingly unrelated regression estimation of a multi-factor model indicates that monetary policy, as measured both by federal funds rate innovations and by narrative measures, is a common factor and that assets must pay a positive risk premium to compensate for their exposure to it. These results support the hypothesis that monetary policy, at least in the short run, has real and quantitatively important effects on the economy.

The next Section discusses the data and methodology employed here. Section II presents the results. Section III concludes and discusses the implications of the findings for further research in financial economics.

I. Data and Methodology

A. Vector Autoregression Evidence of Monetary Policy and Stock Returns

The vector autoregression (VAR) methodology has proven useful for investigating the relationship between stock returns and other variables (see, e.g., Lee (1992)). This involves regressing an n by 1 vector of endogenous variables, $\mathbf{y}_t$, on lagged values of itself:

$$\mathbf{y}_t = \Lambda_1 \mathbf{y}_{t-1} + \ldots + \Lambda_p \mathbf{y}_{t-p} + \varepsilon_t, \quad E(\varepsilon_t \varepsilon_t') = \Omega. \tag{1}$$

Assuming that $\mathbf{y}_t$ is covariance stationary, equation (1) can be inverted and represented as an infinite vector moving average process:

$$\mathbf{y}_t = \varepsilon_t + \Pi_1 \varepsilon_{t-1} + \Pi_2 \varepsilon_{t-2} + \Pi_3 \varepsilon_{t-3} + \ldots. \tag{2}$$

Since the variance-covariance matrix of ε_t (Ω) is symmetric and positive definite, the Cholesky factorization implies that there exists a lower triangular matrix $\mathbf{P}$ such that $\Omega = \mathbf{PP}'$. Using $\mathbf{P}$, equation (2) can be rewritten:

$$\mathbf{y}_t = \mathbf{PP}^{-1}\varepsilon_t + \Pi_1 \mathbf{PP}^{-1}\varepsilon_{t-1} + \Pi_2 \mathbf{PP}^{-1}\varepsilon_{t-2} + \ldots = \Gamma_0 \upsilon_t + \Gamma_1 \upsilon_{t-1} + \Gamma_2 \upsilon_{t-2} + \ldots \tag{3}$$

where $\Gamma_i = \Pi_i \mathbf{P}$, $\upsilon_t = \mathbf{P}^{-1}\varepsilon_t$, and $E[\upsilon_t \upsilon_t'] = \mathbf{I}$. Equation (3) represents the endogenous variables ($\mathbf{y}_t$) as functions of the orthogonalized innovations (υ_{t-i}). One can also determine the percentage of each variable's forecast error variance that is attributable to innovations in each of the endogenous variables.[1]

Bernanke and Blinder (1992), employing this VAR approach, used the federal funds rate to measure monetary policy. Evidence from variance decompositions and Granger causality tests indicated that the funds rate forecasted unemployment, industrial production, and other real variables well over the 1959:7 - 1989:12 period. This is consistent with the hypothesis that monetary policy exerts an important effect on real variables. However, other researchers (e.g., Sims (1992)) presented evidence that casts doubt on the hypothesis that federal funds rate shocks were useful for identifying monetary policy changes. Specifically, these authors found that when the funds rate was placed first in a Cholesky ordering, positive innovations in the funds rate were correlated with subsequent increases in inflation. This increase in inflation in response to a "contractionary" policy shock has been labeled the "price puzzle". As Christiano, Eichenbaum, and Evans (1994) have discussed, this response could occur because the Fed is using some indicator of inflation that the econometrician is not including in the VAR. If the Fed tightens policy in response to this indicator and if the tightening only affects inflation with a lag then contractionary policy will appear to be correlated with higher future inflation. Christiano *et al.* found that including an index of sensitive commodity prices as an additional indicator of inflation eliminated the price puzzle and caused positive innovations in the funds rate to be associated with subsequent decreases in the price level.

This identification strategy of Christiano *et al.* is used here to model monetary policy shocks. A monthly VAR with the growth rate of industrial production, the inflation rate, the log of a commodity price index, the federal funds rate, the log of nonborrowed reserves, the log of total reserves, stock returns, a constant, and six lags is estimated. Orthogonalized innovations in the funds rate are used to measure monetary policy. Following Christiano *et al.* the order of orthogonalization is the same as the order in which the variables are listed above. In addition, since the Federal Reserve targeted nonborrowed reserves (NBR) over the October 1979 - August 1982 period, orthogonalized innovations in NBR are used to measure monetary policy over this period.[2] When NBR is used to measure monetary policy, it is placed ahead of the federal funds rate in the recursive ordering.

The stock return data are for the 22 industries that BRW used. These data come from the Center for Research in Security Prices (CRSP) database and include firms traded for any full calendar year over the 1953-1990 period. Firms are sorted into industries based on two-digit SIC codes and industry portfolio returns are equally weighted averages of the returns on individual firms.

To investigate the effect of monetary policy shocks on these portfolios both impulse responses and innovation accounting methods are used. Since forward-looking investors should quickly capitalize the implications of monetary policy shocks for future cash flows and discount factors, the initial period response of stock returns to a monetary policy shock is examined. Standard errors for these coefficients are calculated by Monte Carlo methods using 300 draws from the posterior distribution of the orthogonalized impulse responses (see Doan (1992)). Since financial economists have found that stock returns are somewhat forecastable (see Campbell and Ammer (1993) and the references contained therein), the percent of the 24-month forecast error variance of stock returns explained by monetary policy shocks is also examined. Standard errors are again calculated using the Monte Carlo methods discussed by Doan with 300 draws from the posterior distribution.

Apart from stock returns, data for the other variables were obtained from the Haver Analytics data tape (the mnemonics for these variables are listed in Table II). Since data on commodity prices are available from Haver Analytics beginning in January 1967 and since the BRW industry stock return data extend to December 1990, the estimation using federal funds rate innovations to measure monetary policy was performed over the 1967:1 - 1990:12 period.[3]

B. Narrative Evidence of Monetary Policy and Stock Returns

Another approach to identifying monetary shocks was pioneered by Friedman and Schwartz (1963). They used Federal Reserve statements and other historical documents over the 1867-1960 period to identify exogenous changes in monetary policy and the responses of real variables. Romer and Romer (1989) extended Friedman and Schwartz's work to include six episodes of monetary tightening after 1960 and found that these periods were followed by contractions in industrial production and increases in unemployment. Presumably if these policy changes did cause real output (and thus firms' cash flows) to decline, stock returns should have declined when the policy shocks occurred. However, a sample with six observations is too small to use in inferring whether monetary policy affects stock returns.

Boschen and Mills (1995) have recently employed this narrative approach to assemble a much larger sample of monetary policy shocks. They constructed an index of monetary policy over the 1953:1-1991:12 period. By examining Federal Open Market Committee records and similar documents, they constructed an index that classified monetary policy into five categories: strongly anti-inflationary (-2), anti-inflationary (-1), neutral (0), pro-growth (1), and strongly pro-growth (2). They found that their index is predictably correlated with money market indicators of monetary policy such as innovations in the federal funds rate and nonborrowed reserves.

Boschen and Mills's index is used here as an alternative way to test whether monetary policy affects stock returns. To do this BRW's stock returns are regressed on the variables used by Chen, Roll, and Ross (1986) and on the Boschen and Mills index. Chen, Roll, and Ross used the Treasury bond/Treasury bill spread (the horizon premium), the corporate bond/Treasury bond spread (the default premium), the monthly growth rate in industrial production, unexpected inflation, and the change in expected inflation. To calculate unexpected inflation they first determined the expected real rate on a one-month Treasury bill using the method of Fama and Gibbons (1984). They subtracted this from the nominal Treasury bill rate (known at the beginning of the month) to calculate expected inflation. Unexpected inflation was set equal to the difference between actual inflation and expected inflation. The change in expected inflation was set equal to the first difference of the expected inflation series. Chen, Roll, and Ross argued that each of the series that they used, being either the difference between asset returns or very noisy, could be treated as innovations. The Boschen and Mills index numbers were also treated as innovations.

The 22 industry stock return equations were estimated as a system, and White's (1984) method was used to obtain heteroskedasticity-consistent standard errors. Expected inflation was estimated jointly with the asset return equations. The sample period employed was the same one (1967:1 - 1990:12) used to estimate the vector autoregressions.

Data on the horizon premium, the default premium, inflation, and the return on Treasury bills were obtained from Ibbotson Associates (1994). Data on industrial production were obtained from the Haver Analytics data tape (its mnemonic is IPN).

C. Event Study Evidence

Cook and Hahn (1989) argued that the Federal Reserve controlled the federal funds rate so closely during the 1974-1979 period that market participants were able to discern a change in the funds rate target on the day that it occurred. They then collected a sample of 76 changes in the funds rate over this period from *Wall Street Journal* articles on the business days following the policy changes.[4]

As Jones (1994) discussed, the Fed abandoned federal funds rate targeting in 1979. From 1979-1982 it targeted nonborrowed reserves. From 1982-1987, it focussed on a borrowing guideline. However, with the appointment of Alan Greenspan on 11 August 1987, the funds rate again became, "the best signal to use in determining when he [Greenspan] is changing policy."[5]

An attempt was made to extend Cook and Hahn's data set by collecting a sample of federal funds rate changes during the Greenspan years that signalled policy changes. A key word search of major newspapers over the 11 August 1987 to 31 December 1994 period was performed. Every reference to federal funds rate was examined to see whether it referred to a policy-induced change. Changes in the funds rate due to technical factors such as corporations withdrawing funds from the banking system to meet tax payments were excluded. Actual policy changes were easy to identify, as financial market observers agree, for instance, that there were 23 funds rate cuts between June 1989 and July 1992 (see Jones (1994) and Grant (1992)) and six increases in 1994 (see Bradsher (1994) and Risen (1994)). Table I lists the dates and amounts of the federal funds rate changes and the percentage changes in the Dow Jones Industrial Average (DJIA) and Dow Jones Composite Average (DJCA) over the 24-hours bracketing the funds rate changes. Data on the DJIA and DJCA indexes were obtained from the *Wall Street Journal Index*.

The following ordinary least squares regression was then estimated:

$$\Delta P_t = \beta_0 + \beta_1 (\Delta FF_t) \tag{4}$$

where ΔP_t is the percentage change in the DJIA or the DJCA over the 24-hours bracketing the news of the funds rate change and ΔFF_t is the amount (in percentage points) by which the Federal Reserve changed the funds rate. β_1 should be less than zero if news of expansionary (contractionary) monetary policy is an event that increases (decreases) future cash flows or decreases (increases) the discount factors at which those cash flows are capitalized.

D. Monetary Policy and Ex-Ante Returns

The three approaches discussed above all investigate the effects of monetary policy shocks on *ex-post* stock returns. It is also desirable to investigate whether monetary policy affects *ex-ante* returns. In a multi-factor model such as the Arbitrage Pricing Theory (Ross (1976)) an asset must pay a premium to compensate for its exposure to common factors but not for its exposure to idiosyncratic risks. In Ross's framework, the return R_{it} on asset i at time t can be written:

$$R_{it} = \lambda_{0t} + \Sigma_j \beta_{ijt} \lambda_{jt} + \Sigma_j \beta_{ijt} f_{jt} + \varepsilon_{it} \tag{5}$$

where λ_{0t} is the risk-free rate, β_{ijt} measures the exposure of asset i to factor j, λ_{jt} is the risk premium associated with factor j, f_{jt} is the unexpected change in factor j, and ε_{it} is a mean-zero error term. The *ex-ante* expected excess return in this framework is then given by a beta-weighted vector of risk premia ($\Sigma_j \beta_{ijt} \lambda_{jt}$). To investigate whether monetary policy affects *ex-ante* returns it is thus necessary to obtain estimates of assets' monetary policy betas and of the risk premium (if any) associated with monetary policy.

To do this, the approach of McElroy and Burmeister (1988) is employed. They used a seemingly unrelated nonlinear regression technique to simultaneously estimate the risk premia and the exposures associated with observable macroeconomic factors. This methodology allowed them to impose the nonlinear cross-equation restrictions that the intercept terms depend on the risk premia. Although their two-stage approach has been criticized, it does deliver consistent estimates of the risk premia and the exposures. It is thus useful for measuring the magnitude of the effect (if any) that monetary policy has on *ex-ante* returns.

The stock return data, as before, were for the 22 industries that BRW investigated. In addition, data on small company stocks (obtained from Ibbotson Associates (1994)) and on eight other industries were included.[6] These last nine portfolios were used in an attempt to increase the cross-sectional variation in expected returns.

The data on macroeconomic factors combined variables to measure monetary policy with the factors employed by Chen, Roll, and Ross (1986). Monetary policy was measured first by innovations in the funds rate from the VAR model described above and second by the Boschen and Mills index. The factors employed by Chen, Roll, and Ross (1986) are described above.[7]

The sample period begins in 1967:7 (because the original VAR used 6 lags) and ends in 1990:12. Each of the regression equations thus has 275 degrees of freedom.

II. Results

Tables II - V report the results of the VAR estimation. Tables II and III indicate that in the initial period a one-standard deviation positive innovation in the funds rate depressed industry stock returns by an average of -0.81 percent per month and a one-standard deviation positive innovation in nonborrowed reserves increased industry stock returns by an average of 1.7 percent per month. These compound to annual effect of -10.2 percent and 23.9 percent respectively. The standard errors indicate that, in most cases, these point estimates are statistically different from zero. Thus expansionary (contractionary) monetary policy, as measured by innovations in both the funds rate and nonborrowed reserves, has a large and statistically significant positive (negative) effect on stock returns.

Tables IV and V present the percent of the 24-month forecast error variance (FEV) of the industry stock returns that is explained by innovations in monetary policy. Table IV indicates that on average 3.84 percent of the FEV of industry returns is explained by funds rate innovations and Table V indicates that on average 14.49 percent of the FEV of industry returns is explained by nonborrowed reserves innovations. The standard errors show that, in most cases, these FEVs are statistically different from zero. Thus monetary policy innovations explain a substantial fraction of industry stock returns.

Table VI reports the results of the estimation using the Boschen and Mills index. It indicates that a one-unit increase in the index (e.g., a change in monetary policy from neutral to pro-growth) would increase industry stock returns by an average of 0.83 percent per month. This compounds to an annual effects of 10.4 percent. The standard errors indicate that, in most cases, these point estimates are statistically different from zero. Thus expansionary (contractionary) monetary policy, as measured by the Boschen and Mills index, has a large and statistically significant positive (negative) effect on stock returns.

The results of regressing the DJIA index on news of federal funds rate changes were (with t-statistics in parentheses):

$$\underset{}{\Delta DJIA_t} = \underset{(1.34)}{0.226} - \underset{(-2.35)}{1.44}\Delta FF_t$$

R-squared = 0.05, Std. Error of Regression = 1.82, N = 116

The results of regressing the DJCA index on news of funds rate changes were:

$$\Delta DJCA_t = \underset{(0.79)}{0.092} - \underset{(-2.47)}{1.04}\Delta FF_t$$

R-squared = 0.05, Std. Error of Regression = 1.25, N = 116

Thus there is a statistically significant negative relationship between policy-induced changes in the funds rate and changes in the DJIA and the DJCA. This finding is consistent with the hypothesis that expansionary (contractionary) monetary policy is an event that increases (decreases) future cash flows or decreases (increases) the discount factors at which those cash flows are capitalized.

Table VII reports the results obtained from estimating the multi-factor model. When monetary policy was measured using the funds rate the risk premium equalled -0.57 percent per month and the mean absolute value of the 22 monetary policy betas was -1.06 percent per month. When monetary policy was measured using the Boschen and Mills index the risk premium equalled 1.10 percent per month and the mean absolute value of the 22 monetary policy betas was 0.68 percent per month. These results imply that on average the expected return on a stock decreased by 0.60 percent per month when monetary policy was measured by the funds rate and by 0.75 percent per month when monetary policy was measured by the Boschen and Mills index. These compound to annual effects of 7.5 percent and 9.4 percent respectively. For the five industries with the largest exposures to monetary policy, these annual effects averaged 10.4 percent when the funds rate was used and 13.4 percent when the Boschen and Mills index was used. These results indicate that monetary policy is a common factor and that assets must pay large positive premiums to compensate for their exposures to it.

The important implication of the results presented above is that monetary policy has real effects, and that these effects are quantitatively important. Whether monetary policy is measured by funds rate innovations, by the Boschen and Mills index, by nonborrowed reserves innovations, or by an event study of funds rate changes, the results indicate that expansionary (contractionary) monetary policy causes stock returns in almost every industry examined to increase (decrease).[8] A one-standard deviation negative shock to the funds rate increases returns by an average annual rate of 10.2 percent; a one-unit increase in the Boschen and Mills index increases annual returns by an average annual rate of 10.4 percent; a one-standard deviation positive shock to nonborrowed reserves increases returns by an average annual rate of 23.9 percent, and a 100 basis point policy-induced decline in the funds rate increases the Dow Jones Industrial Average the same day by an average of 1.44 percent. Thus monetary policy not only has real effects on *ex-post* returns, but also has effects that are quantitatively important. This evidence suggests that monetary policy might also affect *ex-ante* returns. The results of estimating a multi-factor model indicate that monetary policy is a common factor and that exposure to it increases an asset's *ex-ante* return on average by 7.5 percent (when monetary policy is measured using the funds rate) or 9.4 percent (when policy is measured using the Boschen and Mills index). Thus the evidence indicates that monetary policy matters, not only for *ex-post* returns but also for *ex-ante* returns.

III. Conclusion and Implications for Research

Boudoukh, Richardson, and Whitelaw (1994), employing a money-neutral model, presented theoretical and empirical evidence to explain the expected inflation/stock return correlation. In concluding they stated that whether monetary policy matters, and whether it has quantitatively important effects, remain open questions. This paper addresses these questions by examining how BRW's industry stock return data respond to monetary policy shocks. Theory posits that stock prices equal the expected present value of future net cash flows. Thus evidence that positive monetary shocks increase industry stock returns indicates that expansionary monetary policy exerts real effects by increasing future cash flows or by decreasing the discount factors at which those cash flows are capitalized. Using several measures of monetary policy and a variety of empirical techniques, this paper presents evidence that monetary policy exerts large effects on *ex-ante* and *ex-post* stock returns. These findings support the hypothesis that monetary policy, at least in the short run, has real and quantitatively important effects on the economy.

The results presented here suggest several directions of future research for financial economists. First, while the evidence above indicates that monetary policy is a common factor it does not reveal why it affects stock returns. To answer this question the approach of Campbell and Mei (1993) would be useful. They have shown that an asset's beta with a common factor can be decomposed into portions representing the covariance of news about 1) expected future cash flows, 2) expected future interest rates, and 3) expected excess returns with the risk factor. Thus Campbell and Mei's methodology can shed light on the channels through which monetary policy affects stock returns.

A second direction for future research builds on the work of Fama and French (1995). They argued that firm size proxies for sensitivity to an unknown risk factor. They also found that small stocks have lower earnings on book equity than big stocks because, while both were harmed by the recession of 1981-1982, big but not small stocks benefitted from the subsequent expansion. The finding presented here that monetary policy is a risk factor coupled with the theoretical framework of Gertler and Gilchrist (1994) and the empirical evidence reported in Thorbecke and Coppock (1995) provide a possible explanation for Fama and French's results. Gertler and

Gilchrist have argued that a monetary tightening, by increasing interest rates, worsens firms' cash flow net of interest and thus their balance sheet positions. They then argued that the spending of small firms is more dependent on their balance sheet positions because their lower collateralizable net worth constrains their access to credit. Gertler and Gilchrist further argued that these credit constraints bind a larger number of small firms in a downturn, implying that changes in monetary policy should have a larger effect on small firms in bad times than in good times. Building on this insight, Thorbecke and Coppock found that tight monetary policy during the 1981-1982 recession harmed both small and large firms while easier monetary policy during the subsequent expansion benefited large but not small firms. The evidence of an asymmetric response of small stocks to monetary shocks in recessions and expansions together with the finding that monetary policy is a common factor suggests that it might be one of the state variables that produces the size-related variation in returns discussed by Fama and French.

A third direction for future research concerns an explanation for the *unexpected* inflation/stock return correlation. Boudoukh, Richardson, and Whitelaw presented evidence explaining the *expected* inflation/stock return correlation.[9] One explanation for the *unexpected* inflation/stock return correlation has been presented by Tobin (1978, 1988). Tobin argued that financial markets believe that *news* of inflation will generate a monetary tightening by the Federal Reserve that will reduce the present value of future earnings and thus current stock returns. Since many authors (e.g., Bernanke and Blinder (1992) and Fuhrer and Moore (1995)) have demonstrated that news of inflation causes the Federal Reserve to tighten monetary policy, the evidence here indicating that tighter monetary policy depresses stock returns is consistent with Tobin's hypothesis. Future research should investigate the extent to which Tobin's hypothesis can explain the puzzling finding that stocks, which represent claims against real assets, do not provide good hedges against unexpected changes in inflation.

Table I
Changes in the Federal Funds Rate and Stock Returns

The sample contains 116 policy-induced changes in the federal funds rate over the September 1974 - December 1994 period. Funds rate changes for the 1974-1979 period were collected by Cook and Hahn (1989) from *Wall Street Journal* articles on the first business day following the policy change. Funds rate changes after this were collected from a key word search of major newspapers. Data on percentage changes in the Dow Jones Industrial Average (DJIA) and the Dow Jones Composite Average (DJCA) over the 24-hour period bracketing news of the policy change were obtained from the *Wall Street Journal Index*.

	Change in	Percentage Change in Stock Prices	
Date	Funds Rate	DJIA	DJCA
11/15/94	0.75	-0.09	-0.06
8/16/94	0.50	0.64	0.51
5/17/94	0.50	1.33	1.12
4/18/94	0.25	-1.13	-1.11
3/22/94	0.25	-0.06	-0.80
2/4/94	0.25	-2.46	-2.04
9/7/92	-0.25	-0.31	-0.46
7/2/92	-0.50	-0.71	-0.70
4/9/92	-0.25	1.36	1.75
12/20/91	-0.50	0.69	0.79
12/6/91	-0.25	-0.09	-0.01
11/6/91	-0.25	0.24	0.19
10/31/91	-0.25	-0.09	-0.07
9/13/91	-0.25	-0.74	0.63
8/6/91	-0.25	1.27	1.04
4/30/91	-0.25	0.38	0.17
3/8/91	-0.25	-0.28	-0.63
2/1/91	-0.50	-0.21	-0.38
1/8/91	-0.25	-0.53	-0.08
12/19/90	-0.25	0	0.32
12/7/90	-0.25	-0.48	-0.49
11/16/90	-0.25	0.59	0.47
10/29/90	-0.25	-0.24	-0.47
7/12/90	-0.25	1.26	1.07
12/20/89	-0.25	-0.29	-0.21
11/7/89	-0.25	0.58	0.72
10/16/89	-0.25	3.37	-0.42
7/26/89	-0.50	1.15	1.08
7/7/89	-0.25	1.03	1.23
6/6/89	-0.25	0.63	0.35
2/23/89	0.5	0.24	0.45
2/14/89	0.125	-0.06	-0.28

Table I – *Continued*

Date	Change in Funds Rate	Percentage Change in Stock Prices DJIA	DJCA
12/15/88	0.5	-0.06	0.07
8/11/88	0.375	0.25	0.16
5/25/88	0.25	-0.06	-0.02
5/14/88	0.25	1.14	0.85
4/5/88	0.25	0.85	0.60
10/21/87	-0.25	15.38	8.40
10/20/87	-0.75	5.72	2.56
10/8/87	0.20	-1.38	-1.03
9/19/79	0.125	0.26	-0.03
9/4/79	0.125	-1.69	-1.54
8/24/79	0.25	-0.02	-0.22
8/15/79	0.375	1.04	0.81
7/20/79	0.375	0.09	0.20
4/27/79	0.188	-0.50	-0.48
1/15/79	0.125	1.48	0.98
12/19/78	0.125	0.29	-2.16
11/28/78	0.125	-1.19	-1.02
11/1/78	0.25	4.46	4.02
10/31/78	0.375	-2.39	-2.01
10/26/78	0.125	-1.10	-1.38
10/20/78	0.125	-0.99	-1.30
10/18/78	0.125	-0.77	-1.07
9/28/78	0.125	0.13	0.08
9/25/78	0.125	-0.01	0.09
9/25/78	0.125	-0.51	-0.61
9/20/78	0.125	1.57	1.22
9/8/78	0.125	-1.19	-1.07
8/28/78	0.125	-0.37	-0.32
8/18/78	0.125	0.84	0.79
8/16/78	0.125	-0.25	-0.18
7/20/78	0.125	-0.62	-0.62
6/21/78	0.25	-0.87	-0.52
5/18/78	0.25	-1.20	-0.94
4/27/78	0.25	0.59	0.58
4/19/78	0.25	-1.13	-1.36
10/31/77	0.25	-0.53	-0.32
10/7/77	0.125	-0.21	-0.15
9/30/77	0.125	0.84	0.65
9/22/77	0.125	-0.22	-0.08
9/9/77	0.125	-1.28	-1.08
8/12/77	0.125	-0.72	-0.64
8/9/77	0.125	0	-0.15
7/28/77	0.25	0.18	-0.12
5/19/77	0.125	-0.58	-0.49
5/10/77	0.125	0.33	0.39
4/27/77	0.125	0.89	0.91
4/25/77	0.125	-1.34	-1.03
12/14/76	-0.125	0.66	0.68

Table I – *Continued*

Date	Change in Funds Rate	Percentage Change in Stock Prices DJIA	DJCA
11/19/76	-0.25	-0.14	-0.12
10/8/76	-0.25	-1.21	-0.99
7/9/76	-0.25	1.12	1.06
5/19/76	0.125	-0.06	0.10
5/14/76	0.125	-0.85	-0.52
5/12/76	0.125	-0.09	-0.11
5/5/76	0.125	-0.72	-0.52
4/23/76	0.125	-0.70	-0.55
3/30/76	-0.125	-0.53	-0.56
2/27/76	0.25	-0.64	-0.56
1/6/76	-0.126	1.48	1.43
11/12/75	-0.125	1.63	1.54
11/7/75	-0.125	-0.61	-0.34
10/21/75	-0.375	0.54	0.66
10/3/75	-0.125	2.35	1.99
7/22/75	0.125	-0.93	-1.13
7/21/75	0.125	-0.89	-0.67
7/16/75	0.125	-1.10	-1.01
6/20/75	0.50	1.19	0.76
5/8/75	-0.25	0.49	0.44
3/26/75	-0.25	2.45	2.14
2/21/75	-0.25	0.59	0.44
2/14/75	-0.25	1.00	0.59
2/13/75	-0.25	1.66	1.27
1/31/75	-0.50	1.04	0.91
1/14/75	-0.25	0.84	-0.80
1/7/75	-0.25	0.63	0.33
1/6/75	-0.25	0.42	0.97
1/3/75	-0.25	0.39	0.82
1/2/75	-0.25	2.56	2.79
12/16/75	-0.25	-1.00	-0.92
12/3/74	-0.25	-1.06	-1.21
10/18/74	-0.50	-0.53	0.83
10/4/74	-0.25	-0.52	0.22
9/23/74	-0.25	-1.05	-0.56
9/13/74	-0.50	-2.16	-2.35

Table II

Impulse Response of Industry Stock Returns to One-Standard Deviation Shock to the Federal Funds Rate (FF).

The coefficients in the Table represents the 7,4th element of the matrix Γ_0 in the orthogonalized moving average process:

$$\mathbf{y}_t = \Gamma_0 \upsilon_t + \Gamma_1 \upsilon_{t-1} + \Gamma_2 \upsilon_{t-2} + \ldots$$

where $\mathbf{y}_t$ is a (7 x 1) vector whose elements are industrial production growth (IPN), the inflation rate (IFN), the log of an index of sensitive commodity prices (CP), FF, the log of nonborrowed reserves (NBR), the log of total reserves (TR), and stock returns in industry k (SR_k). The order of the variables in the vector $\mathbf{y}_t$ is the same as the order in which they are listed above. Thus the 7,4th element of the matrix Γ_0 measures the response of SR_k in the initial period to a one-standard deviation shock to FF. The original vector autoregression was estimated with a constant and six lags. The sample period extends from January 1967 to December 1990. Data on IPN, IFN, CP, FF, NBR, and TR were obtained from the Haver Analytics data tape. The mnemonics for these variables are, respectively, IPN, PCU, PZALL, FFED, FARAN, and FARAT. Data on SR_k are for two-digit SIC industries and represent equally weighted averages of individual firms' returns obtained from the Center for Research in Security Prices database.

Industry	Response to One-Standard Deviation Shock to FF	(Std. Error)
Apparel	-0.00509	(0.00376)
Chemicals	-0.00642	(0.00313)
Clay, Glass, and Stone	-0.00945	(0.00318)
Electrical Machinery	-0.00735	(0.00424)
Food and Beverage	-0.00773	(0.00280)
Furniture	-0.00950	(0.00339)
Instruments	-0.00741	(0.00374)
Leather	-0.00662	(0.00104)
Lumber	-0.0142	(0.00527)
Metal Products	-0.00774	(0.00323)
Mining	-0.0134	(0.00374)
Misc. Manufacturing	-0.00776	(0.00395)
Nonelectrical Machinery	-0.00894	(0.00363)
Paper	-0.00884	(0.00333)
Petroleum Products	-0.0076	(0.00331)
Primary Metals	-0.00879	(0.00338)
Printing and Publishing	-0.00664	(0.00331)
Rubber and Plastics	-0.00791	(0.00321)
Textiles	-0.00635	(0.00362)
Tobacco	-0.00583	(0.00259)
Transportation Equipment	-0.00803	(0.00386)
Utilities	-0.00662	(0.00186)

Table III
Impulse Response of Industry Stock Returns to One-Standard Deviation Shock to the Log of Nonborrowed Reserves (NBR).
The coefficients in the Table represents the 7,4th element of the matrix Γ_0 in the orthogonalized moving average process:

$$\mathbf{y}_t = \Gamma_0 \upsilon_t + \Gamma_1 \upsilon_{t-1} + \Gamma_2 \upsilon_{t-2} + \ldots$$

where $\mathbf{y}_t$ is a (7 x 1) vector whose elements are industrial production growth (IPN), the inflation rate (IFN), the log of an index of sensitive commodity prices (CP), NBR, the federal funds rate (FF), the log of total reserves (TR), and stock returns in industry k (SR_k). The order of the variables in the vector $\mathbf{y}_t$ is the same as the order in which they are listed above. Thus the 7,4th element of the matrix Γ_0 measures the response of SR_k in the initial period to a one-standard deviation shock to NBR. The original vector autoregression was estimated with a constant and two lags. The sample period extends from October 1979 to August 1982. Data on IPN, IFN, CP, NBR, FF, and TR were obtained from the Haver Analytics data tape. The mnemonics for these variables are, respectively, IPN, PCU, PZALL, FARAN, FFED, and FARAT. Data on SR_k are for two-digit SIC industries and represent equally weighted averages of individual firms' returns obtained from the Center for Research in Security Prices database.

Industry	Response to One-Standard Deviation Shock to FF	(Std. Error)
Apparel	0.0107	(0.0101)
Chemicals	0.0169	(0.00716)
Clay, Glass, and Stone	0.0256	(0.00881)
Electrical Machinery	0.0151	(0.00988)
Food and Beverage	0.0119	(0.00689)
Furniture	0.0190	(0.00979)
Instruments	0.0227	(0.00958)
Leather	0.0101	(0.00719)
Lumber	0.0223	(0.0106)
Metal Products	0.0153	(0.0100)
Mining	0.0285	(0.0128)
Misc. Manufacturing	0.0126	(0.00923)
Nonelectrical Machinery	0.0221	(0.00869)
Paper	0.0186	(0.00873)
Petroleum Products	0.0314	(0.0131)
Primary Metals	0.0208	(0.0107)
Printing and Publishing	0.0194	(0.00754)
Rubber and Plastics	0.0137	(0.00893)
Textiles	0.0125	(0.00815)
Tobacco	0.0114	(0.00675)
Transportation Equipment	0.0134	(0.0112)
Utilities	0.0181	(0.00504)

Table IV

Percent of 24-Month Forecast Error Variance (FEV) of Industry Stock Returns Accounted for by Innovations in the Federal Funds Rate (FF)

The contribution of FF shocks to the FEV of industry stock returns is estimated using a VAR system $\mathbf{y}_t$ with industrial production growth (IPN), the inflation rate (IFN), the log of an index of sensitive commodity prices (CP), FF, the log of nonborrowed reserves (NBR), the log of total reserves (TR), stock returns in an industry (SR_k), a constant, and six lags. $\mathbf{y}_t$ depends on orthogonalized innovations in all the variables (υ_{t-i}):

$$\mathbf{y}_t = \Gamma_0\upsilon_t + \Gamma_1\upsilon_{t-1} + \Gamma_2\upsilon_{t-2} + \ldots$$

The percentage contribution of an innovation in variable *j* to the 24-month FEV of variable *i* is then given by:

$$100 \times \sum_{s=0}^{23} \Gamma_{s,ij}^2 \Big/ \sum_{j=1}^{4} \sum_{s=0}^{23} \Gamma_{s,ij}^2.$$

The contribution of an innovation in FF to the 24-month FEV of SR is reported below. The order of orthogonalization in calculating this was IPN, IFN, CP, FF, NBR, TR, and SR_k. The sample period extends from January 1967 to December 1990. Data on IPN, IFN, CP, FF, NBR, and TR were obtained from the Haver Analytics data tape. The mnemonics for these variables are, respectively, IPN, PCU, PZALL, FFED, FARAN, and FARAT. Data on SR_k are for two-digit SIC industries and represent equally weighted averages of individual firms' returns obtained from the Center for Research in Security Prices database.

Industry	Percent of 24-month FEV Explained by FF innovation	(Std. Error)
Apparel	2.37	(0.94)
Chemicals	2.82	(1.15)
Clay, Glass, and Stone	4.60	(1.60)
Electrical Machinery	4.30	(1.03)
Food and Beverage	3.51	(1.76)
Furniture	3.97	(1.37)
Instruments	3.78	(1.06)
Leather	2.97	(1.20)
Lumber	3.61	(1.54)
Metal Products	4.03	(1.32)
Mining	6.25	(2.19)
Misc. Manufacturing	3.11	(1.20)
Nonelectrical Machinery	4.86	(1.31)
Paper	3.26	(1.17)
Petroleum Products	3.18	(1.23)
Primary Metals	4.92	(1.50)
Printing and Publishing	3.37	(1.21)
Rubber and Plastics	4.00	(1.24)
Textiles	2.48	(1.04)
Tobacco	3.01	(1.24)
Transportation Equipment	3.70	(1.21)
Utilities	5.13	(2.03)

Table V

Percent of 24-Month Forecast Error Variance (FEV) of Industry Stock Returns Accounted for by Innovations in Nonborrowed Reserves (NBR)

The contribution of NBR shocks to the FEV of industry stock returns is estimated using a VAR system $\mathbf{y}_t$ with industrial production growth (IPN), the inflation rate (IFN), the log of an index of sensitive commodity prices (CP), the federal funds rate (FF), the log of nonborrowed reserves (NBR), the log of total reserves (TR), stock returns in industry k (SR_k), a constant, and two lags. $\mathbf{y}_t$ depends on orthogonalized innovations in all the variables (υ_{t-i}):

$\mathbf{y}_t = \Gamma_0\upsilon_t + \Gamma_1\upsilon_{t-1} + \Gamma_2\upsilon_{t-2} + \ldots$

The percentage contribution of an innovation in variable j to the 24-month FEV of variable i is then given by:

$$100 \times \sum_{s=0}^{23} \Gamma_{s,ij}^2 \Big/ \sum_{j=1}^{4} \sum_{s=0}^{23} \Gamma_{s,ij}^2 .$$

The contribution of an innovation in NBR to the 24-month FEV of SR is reported below. The order of orthogonalization in calculating this was IPN, IFN, CP, NBR, FF, TR, and SR_k. The sample period extends from October 1979 to August 1982. Data on IPN, IFN, CP, FF, NBR, and TR were obtained from the Haver Analytics data tape. The mnemonics for these variables are, respectively, IPN, PCU, PZALL, FFED, FARAN, and FARAT. Data on SR_k are for two-digit SIC industries and represent equally weighted averages of individual firms' returns obtained from the Center for Research in Security Prices database.

Industry	Percent of 24-month FEV Explained by FF innovation	(Std. Error)
Apparel	9.24	(5.68)
Chemicals	16.37	(6.40)
Clay, Glass, and Stone	19.44	(8.51)
Electrical Machinery	13.83	(5.00)
Food and Beverage	12.09	(4.69)
Furniture	13.76	(6.50)
Instruments	17.53	(6.06)
Leather	8.42	(5.92)
Lumber	13.82	(5.99)
Metal Products	13.70	(5.44)
Mining	18.30	(6.40)
Misc. Manufacturing	12.93	(4.72)
Nonelectrical Machinery	19.63	(6.07)
Paper	14.49	(6.37)
Petroleum Products	19.28	(8.45)
Primary Metals	14.13	(6.50)
Printing and Publishing	16.69	(7.03)
Rubber and Plastics	11.61	(5.83)
Textiles	11.38	(5.18)
Tobacco	7.51	(1.24)
Transportation Equipment	13.03	(5.15)
Utilities	21.69	(9.24)

Table VI
The Relation Between Industry Stock Returns and Narrative Evidence of Monetary Policy.

The table reports each industry's monetary policy beta. Industry stock return data are for two-digit SIC industries and represent equally weighted averages of individual firms' returns obtained from the Center for Research in Security Prices database. Monetary policy is measured by the Boschen and Mills (1995) index of the stance of monetary policy. The other right hand side variables were the horizon premium, the default premium, the growth rate of industrial production, unexpected inflation, and the change in expected inflation. Expected inflation was obtained by subtracting the expected real rate on a one-month Treasury bill (calculated using the method of Fama and Gibbons (1984)) from the nominal Treasury bill rate known at the beginning of the month. Unexpected inflation equals the difference between actual inflation and expected inflation. The change in expected inflation is the first difference of the expected inflation series. Data on the horizon premium, the default premium, inflation, and Treasury bill returns were obtained from Ibbotson Associates (1994). Data on the growth rate of industrial production were obtained from the Haver Analytics data tape (mnemonic = IPN). The sample period extends from January 1967 to December 1990. All estimation is performed jointly and the standard errors are adjusted for heteroskedasticity.

Industry	Monetary Policy Beta	(Std. Error)
Apparel	0.0140	(0.0049)
Chemicals	0.0061	(0.0034)
Clay, Glass, and Stone	0.0085	(0.0037)
Electrical Machinery	0.0108	(0.0048)
Food and Beverage	0.0070	(0.0030)
Furniture	0.0111	(0.0043)
Instruments	0.0084	(0.0044)
Leather	0.0150	(0.0041)
Lumber	0.0109	(0.0065)
Metal Products	0.0090	(0.0041)
Mining	-0.0015	(0.0047)
Misc. Manufacturing	0.0083	(0.0045)
Nonelectrical Machinery	0.0091	(0.0041)
Paper	0.0064	(0.0036)
Petroleum Products	0.0005	(0.0039)
Primary Metals	0.0054	(0.0039)
Printing and Publishing	0.0077	(0.0039)
Rubber and Plastics	0.0127	(0.0040)
Textiles	0.0142	(0.0042)
Tobacco	0.0025	(0.0028)
Transportation Equipment	0.0122	(0.0043)
Utilities	0.0031	(0.0020)

Table VII
Nonlinear Seemingly Unrelated Regression (NLSUR) Estimates of the Risk Premiums Associated with Macroeconomic Factors

The risk premia are NLSUR estimates of the λ_{jt} in the equation:

$$R_{it} = \lambda_{0t} + \Sigma_j\beta_{ijt}f_{jt} + \Sigma_j\beta_{ijt}\lambda_{jt} + \varepsilon_{it}$$

where R_{it} represents the return at time t on an industry portfolio, λ_{0t} is the return on one-month Treasury bills, β_{ijt} is the exposure of asset i to the macroeconomic factor j, f_{jt} is the innovation in the macroeconomic factor j, λ_{jt} is the risk premium associated with macroeconomic factor j, and ε_{it} captures the effect of idiosyncratic factors on R_{it}. Industry stock return data are for two-digit SIC industries and represent equally weighted averages of individual firms' returns obtained from the Center for Research in Security Prices database. The macroeconomic factors are monetary policy, the horizon premium, the default premium, the growth rate of industrial production, unexpected inflation, and the change in expected inflation. Monetary policy is measured either by the Boschen and Mills (1995) index or by federal funds rate innovations from a VAR system composed of industrial production growth (IPN), the inflation rate (PCU), the log of an index of sensitive commodity prices (PZALL), the federal funds rate (FFED), nonborrowed reserves (FARAN), and the log of total reserves (FARAT). Expected inflation was obtained by subtracting the expected real rate on a one-month Treasury bill (calculated using the method of Fama and Gibbons (1984)) from the nominal Treasury bill rate known at the beginning of the month. Unexpected inflation equals the difference between actual inflation and expected inflation. The change in expected inflation is the first difference of the expected inflation series. Data on the horizon premium, the default premium, inflation, and Treasury bill returns were obtained from Ibbotson Associates (1994). Data on variables in the VAR system were obtained from the Haver Analytics data tape. The Haver mnemonics are in parentheses next to these variables. The sample period extends from July 1967 to December 1990.

Macroeconomic Factor	Risk Premium	(Std. Error)	Risk Premium	(Std. Error)
Boschen & Mills Index	1.10	0.39		
Federal Funds Rate			-0.57	0.25
The Horizon Premium	0.95	0.48	1.18	0.60
The Default Premium	-1.06	0.39	-1.09	0.48
Industrial Production	-0.0063	0.0023	-0.0081	0.0030
Unexpected Inflation	0.00006	0.00074	0.0014	0.0011
Change in Expected Inflation	-0.0015	0.00055	-0.0020	0.0008

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NOTES

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1. The variance-covariance matrix of the k-period-ahead forecast error is:

$$\mathrm{Var}[\mathbf{y}_{t+k} - E(\mathbf{y}_{t+k}|\mathbf{y}_t, \mathbf{y}_{t-1}, \mathbf{y}_{t-2}, \ldots)] = \Gamma_0\Gamma_0' + \Gamma_1\Gamma_1' + \ldots + \Gamma_{k-1}\Gamma_{k-1}'.$$

The contribution of the *j*th orthogonalized innovation to the k-period-ahead FEV is:

$$\Gamma_{0,j}\Gamma_{0,j}' + \Gamma_{1,j}\Gamma_{1,j}' + \ldots + \Gamma_{k-1,j}\Gamma_{k-1,j}',$$

where $\Gamma_{0,j}$ is the *j*th column of the matrix Γ_0. The contribution of an innovation in the *j*th variable to the k-period-ahead FEV in the *i*th variable is then given by:

$$\sum_{s=0}^{k-1} \Gamma_{s,ij}^2 \Big/ \sum_{j=1}^{n} \sum_{s=0}^{k-1} \Gamma_{s,ij}^2,$$

where $\Gamma_{s,ij}$ is the *ij*th element of the matrix Γ_s.

2. Since this sample period contains only 34 observations, this VAR system was estimated with two lags of each of the variables.

3. October 1987, the month of the October 19th stock market crash and the subsequent easing of monetary policy on October 20th and 21st, was deleted from the estimation in this and the next section.

4. Cook and Hahn (1989) showed that increases (decreases) in the funds rate over the 1974-1979 period were correlated with increases (decreases) in short and long term interest rates. Thorbecke and Alami (1994) showed that these increases (decreases) over the 1974-1979 period were correlated with decreases (increases) in stock returns.

5. Jones (1994) p. 95.

6. I thank Jacob Boudoukh for kindly providing the data for all thirty industries.

7. Thorbecke and Coppock (1995) also estimated a multi-factor model including a measure of monetary policy. The estimation here differs because the sample period is much longer, because both VAR and narrative indicators are used to measure monetary policy, and because BRW's data set is used.

8. The fact that four different measures of monetary policy all yielded similar results implies that our findings are not merely capturing an interest rate effect but rather are providing evidence concerning how monetary shocks affect stock returns.

9. It seems probable that a result which has puzzled scholars for as long as the negative inflation/stock return correlation has should have more than one cause. In addition to BRW's explanation, another interesting hypothesis has been advanced by Stulz (1986). He argued that an increase in expected inflation, by decreasing real wealth, could decrease real interest rates and the expected real rate on the market portfolio.