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MONETARY REGIMES AND THE RELATION BETWEEN STOCK RETURNS AND INFLATIONARY EXPECTATIONS

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Abstract

This paper analyzes the impact of changes in monetary policy regimes on the relation between stock returns and changes in expected inflation. Post-war evidence from four countries reveals a direct link between these relations and the central banks' operating targets (i.e., money supply or interest rates). Specifically, the post-war negative relations between stock returns and changes in expected inflation are significantly stronger during interest rate regimes.

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1. INTRODUCTION

International evidence has revealed a puzzling relation between stock returns and inflation in the post-war period. Real stock returns appear to be negatively related to expected, unexpected, and changes in expected inflation [e.g., Bodie (1976), Jaffe and Mandelker (1976), Nelson (1976), Fama and Schwert (1977), Gultekin (1983), Solnik (1983), and Kaul (1986)]. This paper analyzes the impact of changes in monetary regimes on the relations between real stock returns and unexpected inflation/changes in expected inflation.

The negative relation between stock returns and inflation is puzzling because it is counter-intuitive. The Fisher equation for risky assets implies a positive relation between stock returns and ex ante expected inflation. On the other hand, a positive response of stock prices to unexpected inflation is suggested by the traditional view that common stocks, as claims against real assets, should be a good hedge against inflation.

Geske and Roll (1983) contend that the "true" relation is between stock returns and changes in expected inflation.[1] An unanticipated drop in stock prices signals a fall in future real activity which, in turn, leads to an increase in government deficits (given largely fixed expenditures and a decrease in tax revenues). To the extent that there is debt-monetization, these deficits are expected to lead to a (counter-cyclical) increase in money growth and, consequently, to an increase in expected inflation. Thus, stock prices are negatively related to changes in expected inflation because of this "reverse causality" link, and the negative stock return-unexpected inflation

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[1] A number of other explanations have been suggested for the anomalous stock return-inflation relations. For example, see Fama (1981), Lintner (1975) Modigliani and Cohn (1979), and Summers (1981).

relation simply proxies for this effect. Geske-Roll provide empirical support for their hypothesis using U.S. data for the post-war period.[2]

In a recent paper, Kaul (1986) shows that stock return-inflation relations can be explained by the equilibrium process in the monetary sector. More importantly, these relations vary over time in a systematic manner depending on the influence of money demand and supply factors. Specifically, money demand effects combined with a (deficit-induced) counter-cyclical monetary response lead to negative stock return-inflation relations in the post-war period. Conversely, however, money demand factors combined with a pro-cyclical monetary policy in the 1930's lead to insigificant, or even positive, relations between stock returns and inflation.

This paper analyzes the impact of changes in monetary regimes on the relation between stock returns and changes in expected inflation in the post-war period. Specifically, we analyze the impact of changes in the operating targets of the monetary authorities on the stability of these relations. The hypothesis is that periods during which a central bank tries to smooth interest rate movements witness a greater degree of debt-monetization and, hence, a stronger counter-cyclical monetary response. This, in turn, leads to strong negative relations between stock returns and changes in expected inflation. On the other hand, if the monetary authorities attempt to monitor money supply movements the link between deficits and money is weak. Money supply targets are fixed independently which leads to a neutral, or relatively weak counter-cyclical, monetary response. Consequently, such monetary regimes witness weak stock return - changes in expected inflation relations. Therefore, we should

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[2]Solnik (1983) also presents some international evidence in favor of the reverse causality hypothesis.

witness a significant difference in the stock return - changes in expected inflation relation between interest rate and money supply regimes.

To test this hypothesis we use post-war data from four developed countries--the U.S., Canada, the U.K., and Germany. Based on official statements by the monetary authorities, different monetary policy regimes are identified in the four countries.

The evidence from all four countries supports the reverse causality hypothesis as an explanation for the negative stock return - changes in expected inflation relations in the post-war period. More importantly, the evidence also indicates that these relations vary across monetary regimes. Specifically, the negative relation between stock returns and changes in expected inflation is significantly stronger during interest rate regimes. Moreover, there is no change in these relations in countries which experience only one type of monetary regime during our entire sample period (i.e., the U.K. and Germany). However, probably due to the substantial noise generated in short-term base money changes by the multiplicity and complexity of the central banks' transactions in treasury securities, we are unable to detect any significant differences in the degree of debt-monetization across the shorter sub-periods.

Section 2 reviews the relevant literature and outlines the hypothesis. Section 3 describes the data and presents the empirical evidence. The summary and conclusions are presented in Section 4.

2. STOCK RETURNS, CHANGES IN EXPECTED INFLATION, AND THE MONEY SUPPLY PROCESS

Several explanations have been offered for the negative relation between stock returns and unexpected inflation, but most do not hold up well under

empirical investigation.[3] Geske and Roll (1983), however, provide an explanation which seems plausible and has some empirical support [e.g., Geske and Roll (1983), Solnik (1983), and Kaul (1986)].

A. The Background

Geske-Roll argue that the "true" economic relation is between stock returns and changes in expected inflation, and that this relation can easily be reconciled with the negative stock return-unexpected inflation relation. Unexpected inflation is likely to be positively related to (and cause) changes in expected inflation. Following Geske-Roll, consider a simple adaptive expectations model:

$$EI_t = EI_{t-1} + \gamma\,[I_t - EI_{t-1}] + \eta_t \qquad (1)$$

where EI_t = expected inflation over period t to t+1 as of t,

γ = speed of adjustment coefficient,

η_t = disturbance term,

and $\gamma > 0$.

If the true relation is between stock returns and changes in expected inflation, ΔEI_t, the contemporaneous unexpected inflation variable, UI_t, could serve as a proxy. Fama and Schwert (1977) and Kaul (1986) use the change in expected inflation in their stock return-inflation regressions and it does (usually) cause the unexpected inflation measure to become insignificant.

The economic rationale for the negative relation between stock returns and changes in expected inflation is the reverse causality hypothesis. Geske-Roll contend that movements in stock prices cause (in an econometric sense) changes in inflationary expectations. An unanticipated drop in stock prices is a

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[3] Summers (1981) and French, Ruback, and Schwert (1983) present some empirical evidence relating to various hypotheses.

signal for a drop in anticipated economic activity and, therefore, in government revenues. Given largely fixed government expenditures (called entitlements) a decrease in revenues, in turn, leads to the expectation that the government will run a deficit and, to the extent that deficits are monetized, there will be a consequent increase in expected inflation. Thus, a (deficit-induced) counter-cyclical monetary response leads to a negative relation between stock returns and changes in expected inflation.[4]

In a recent paper, Kaul (1986) shows that stock return-inflation relations can be explained by the equilibrium process in the monetary sector. More importantly, these relations vary over time in a systematic manner depending on the influence of money demand and supply factors. Specifically, money demand effects combined with a (deficit-induced) counter-cyclical monetary response lead to negative stock return-inflation relations in the post-war period. Conversely, however, money demand factors combined with a pro-cyclical monetary policy in the 1930's lead to insignificant, or even positive, relations between stock returns and inflation.

B. The Hypothesis

In this paper, we analyze the impact of changes in monetary regimes on the relation between stock returns and changes in expected inflation in the post-war period. The hypothesis is that there is a direct link between these relations and a central bank's operating targets (i.e., money supply or interest rates).

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[4]The importance of the reverse causality link between stock returns and changes in expected inflation is also suggested by studies which test the relation between money and stock prices using the standard quantity theory - efficient market approach [e.g., Cooper (1974), Rozeff (1974), and Rogalski and Vinso (1977)]. Most of these studies find that the stock market is efficient and that future money growth rates affect current stock returns. In a recent paper, James, Koreisha, and Partch (1985) use a VARMA model and find strong evidence in favor of the reverse causality argument.

Specifically, if a central bank is committed to a policy of controlling interest rate movements, an increase in the deficit forces it to conduct open market purchases to keep the (real) interest rate from rising.[5] Thus, there is a link between government borrowing and the central bank's open market purchases. These open market purchases, in turn, lead to an increase in high-powered money.[6] Consequently, targeting on interest rates leads a central bank to follow a counter-cyclical monetary policy. On the other hand, a central bank's commitment to produce a given money stock weakens the link between deficits and high-powered money. Under such conditions, the central bank

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[5]This argument is based on a Keynesian economic scenario. Specifically if the deficits are not monetized real interest rates rise because the Treasury has to offer higher rates to finance the debt by borrowings from the public. Barro (1979) argues that this real interest rate effect may be neutralized by rational consumers discounting all future tax liabilities implicit in increases in government debt. Whether such neutralization does take place, however, is an empirical issue.

On the other hand, members of the Federal Reserve Board believe they can influence interest rates in a downward direction by increasing high-powered money (and vice versa). This belief is reinforced by the reliability with which interest rates respond to the Fed's interventions. Since it is unlikely that nominal interest rates fall because of a decrease in in inflationary expectations (caused by increases in money), the Fed must have some influence over real rates [see Shiller (1980)]. In a recent paper, Hoelscher (1986) uses a loanable funds framework to show a strong, robust, and significant positive relation between deficits and long-term interest rates in the U.S.

[6]The issue of debt-monetization has generated a lot of controversy in both the theoretical and empirical literature; and there is no clear answer as to whether the government must monetize its debt. Barro (1979) argues that the only reason nominal deficits and money growth could be related is because the government is concerned with the real value of its debt. Consequently, it allows the nominal debt to grow in direct proportion to the inflation rate. On the other hand, Sargent and Wallace (1981) present a model in which fiscal policy dominates monetary policy. Specifically, the time paths of government expenditures and revenues are fixed. Under these circumstances, if the government deficits cannot be financed solely by new bond sales to the public, the central bank is forced to create money and tolerate additional inflation. A similar argument is also put forward by Dornbusch and Fischer (1981).

The empirical evidence also provides no conclusive results. Froyen (1974), Hamburger and Zwick (1981), Levy (1981), and Allen and Smith (1983) all report a significant positive relation between deficits and money growth. On the other hand, Niskanen (1978), King and Plosser (1985), and Joines (1985) find no significant relations.

creates high-powered money so as to achieve a particular (targeted) money growth rate. Hence, monetary responses are either neutral or at least not as strongly counter-cyclical as during interest rate regimes. Consequently, strong negative relations between stock returns and changes in expected inflation would exist during periods in which the central bank is trying to smooth interest rate movements, whereas these relations will be weak when the policy is to monitor money supply movements. Thus, we should witness a significant difference in the negative stock return - changes in expected inflation relation between interest rate and money supply regimes.

3. EMPRIRICAL EVIDENCE

The hypothesis of this paper is tested using post-war data of four developed countries--the U.S., Canada, the U.K., and Germany. The selection of these four countries is based on two considerations: (1) they apparently have industrialized economies with well-developed capital markets, and (2) data for the post-war period (of all the relevant series) is readily available.

A. Data Description

Most U.S. data are obtained from the Survey of Current Business (Business Statistics 1982) and various annual supplements. The revised monetary variables, in particular the adjusted monetary base series, were provided by the Federal Reserve Bank of St. Louis. Stock return (NYSE value-weighted index) and treasury bill rate data were made available by the Center for Research in Security Prices (CRSP).

All of the Canadian data were obtained from the annual supplements of the Statistical Review. The German and the U.K. data are accessed from the IFS tapes. The stock return data exhibit first order serial correlation because the price series are averages of daily figures. Since monthly data are not

available on the IFS tapes (except for the post-1971 period), both German and the U.K. data analysis is confined to annual and quarterly data.

All of the data, with the exception of the industrial production series for Germany and the U.K., are seasonally unadjusted.

B. The Regimes

Based on an analysis of official statements of the monetary authorities, we identify three money supply control periods [namely, 1953-1960 and 1979-198 for the U.S., and 1951-1960 for Canada] and four interest rate policy regimes [i.e., 1961-1979 for the U.S., 1961-1983 for Canada, and 1957-1983 for the U.K and Germany, respectively]. A detailed description of these various monetary regimes is presented in the Appendix.[7]

C. Expected Inflation Forecasts

The first step in testing the hypothesis of this paper is to obtain reliable estimates of expected inflation and the implied estimates of unexpected inflation and changes in expected inflation. We use two methods to extract expected inflation forecasts:

(1) For the U.S. (monthly and quarterly), the U.K. (quarterly), and Canada (quarterly) we use the methodology of Fama and Gibbons (1984). This method extracts expected inflation forecasts, EI_{t-1}, from treasury bill rates by assuming that expected real returns follow a random walk.[8]

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[7] Bradley and Jansen (1986) use stochastic money market models to demonstrate that the Fed did change its operating procedure in October 1979. In addition, Shiller (1980) and Huizinga and Mishkin (1985) provide strong evidence of shifts in the stochastic process of real rates after the Fed-Treasury Accord and the October 1979 monetary regime change, respectively. This evidence supports the basis of our regime identification, and also gives credibility to our expectation that monetary regimes have significant effects on the economy.

[8] There is evidence that expected real returns follow a random walk [e.g., Hess and Bicksler (1975), Garbade and Watchel (1978), and Fama (1981)].

(2) In cases where treasury bill rate data are not available [i.e., Germany (quarterly) and Canada (monthly)], we use ARIMA time series models for the inflation series. We also estimate such time series models for the other countries to compare the two different EI_{t-1} forecasts.[9] The quarterly Canadian data is the only case in which the time series forecasts dominate (in terms of unbiasedness, serial independence of residuals, and low residual standard errors) the forecasts from the interest rate model.

The expected inflation series generally possess good properties as proxies for expected inflation. In regressions of inflation rates on the expected inflation estimates, the inflation forecasts exhibit: (1) conditional unbiasedness, i.e., an intercept close to zero and a slope coefficient close to one (2) serially uncorrelated residuals, and (3) low residual standard errors.[10]

Finally, considering that the post-war sample covers over 30 years for the U.S. and Canada, we re-estimate the expected inflation forecasts for each policy regime separately. These sub-period estimates statistically dominate (in terms of the three criteria mentioned above) the forecasts derived from models fitted to the entire sample periods. The results reported in this paper use the sub-period expected inflation forecasts in the different regime regressions.

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[9] For all countries an IMA (1,1) time series model is the most parsimonious, and provides the best fit.

[10] In the absence of yearly treasury bill rates, we obtain annual expected inflation estimates by multiplying EI_{t-1} for the first quarter (month) of each year by four (twelve). This procedure is valid since shorter term expected inflation forecasts are close to a random walk; the levels are highly autocorrelated, whereas first differences behave like white noise. The German evidence is the only exception to this general finding.

D. Stock Return-Inflation Relations

We estimate a regression of the form:

$$RRS_t = \alpha + \beta_1 EI_{t-1} + \beta_2 \Delta EI_t + \eta_t \qquad (2)$$

where RRS_t = real stock returns (continuously compounded),

EI_{t-1} = expected inflation over period t-1 to t as of t-1,

ΔEI_t = change in expected inflation from period t-1 to t,

and η_t = disturbance term.

Quarterly estimates of equation (2) for the different countries are presented in Table 1.[11]

A few general observations can be made about these relations:

(1) Real stock returns are negatively related to both of the inflation variables (EI_{t-1} and ΔEI_t) in all four countries. Thus, the anomalous stock return-inflation relations are not peculiar to the U.S.

The consistently negative stock returns-inflation relations across all countries could reflect international correlation between the different stock return indices and/or the inflation processes. To account for such interdependence we re-estimate the regressions using Zellner's (1962) "seemingly unrelated regression" method (SURM). Specifically, the errors of the different stock return-inflation regressions are allowed to have different variances and correlations between countries while following standard least squares (OLS) assumptions within each country.

The quarterly OLS vs. SURM regressions (1958-1983) are reported in Table 2. As far as the significant negative stock return-inflation relations are concerned the two techniques yield very similar results.

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[11] Monthly and annual estimates reveal similar relations. More detailed results are provided in Table 3.

(2) Geske-Roll accept that the reverse causality explanation "may not be the whole story" as far as the stock return-expected inflation relation is concerned since it requires a positive simple correlation between expected inflation and stock returns. Most studies (including this paper), however, find the actual correlation to be consistently negative.[12]

In regard to the basis of the negative stock return - changes in expected inflation relation, Kaul (1986) estimates a money supply reaction function and presents evidence in favor of a (deficit-induced) counter-cyclical monetary policy in the overall post-war period in all four countries.[13]

Hence, for the overall sample periods of all four countries, the evidence appears to support the reverse causality hypothesis as an explanation for the negative stock return - changes in expected inflation relations.

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[12]Kaul (1986) has shown that Fama's (1981) proxy hypothesis explains the negative relation between real stock returns and ex ante expected inflation. The proxy hypothesis claims that this negative relation is a consequence of two crucial links: (1) the existence of stagflation, and (2) a positive relation between stock returns and anticipated real variables. Consequently, the inclusion of future real variables in stock return inflation regressions should (and does) eliminate the expected inflation effect in all four countries.

[13]The statistical significance of the money-deficit relation is apparently not a seasonal phenomenon because deseasonalized deficit data also yield similar results. Froyen (1974) and Hamburger and Zwick (1981) also find a significant money-deficit relation in the U.S.

Following Barro (1977), the unemployment rate is also included in the reaction function to evaluate whether the central banks simply followed a counter-cyclical monetary policy, independent of the deficit effect. However, the data appears to indicate that deficits do not serve merely as a cyclical indicator; they seem to exert an independent pressure on money growth (at least during the post-war period). Nevertheless, the eventual effect of deficits is to produce counter-cyclical movements in the money supply.

Some other studies also estimate similar regressions. Hamburger and Zwick (1981), for example, report results that are consistent with our estimates. On the other hand, Joines (1985) finds that money growth and deficits have an insignificant positive relation after controlling for the level of overall activity. However, unlike the quarterly regressions reported in this paper, these studies use annual data.

E. Stability of the Stock Return - Changes in Expected Inflation Relation Across Post-war Monetary Regimes

In this section we test for the stability of the stock return - changes in expected inflation relation across different monetary policy regimes during the post-war period. The main hypothesis of this paper is that we should witness a significant difference in the negative relation between stock returns and changes in expected inflation between interest rate and money supply regimes. Specifically, the negative relation should be statistically stronger during interest rate control periods.

The estimated regressions are presented in Table 3.

1. United States

For the U.S., the three monetary regimes are: two money supply (1953-1960 and 1979-1983) and one interest rate (1961-1979). The salient features of estimates of the stock return - changes in expected inflation relation in these regimes are:

(1) During the interest rate regime there is a significant negative relation between real stock returns and changes in expected inflation in both monthly and quarterly regressions.

(2) This relation, though still negative, is significantly weaker during the money supply regimes. For example, in the monthly regressions the coefficient of ΔEI_t for the 1961-1979 period has a value of -22.13 with a t-statistic of -3.73; while during the 1951-1960 period it is -6.20 with a t-statistic of -0.68 and in the post-1979 years the coefficient again has a comparatively low value of -4.50 with a t-statistic of -1.79. Hence, the coefficient of ΔEI_t appears to be around 4 to 5 times larger during the interest rate regime.

Similarly, in the quarterly regressions the coefficient of ΔEI_t during the interest rate regime is around 3 times as large as its corresponding money supply regime values. For the 1979-1983 sub-period the coefficient is significant at conventional confidence levels, but our primary concern is whether there is a significant difference in the coefficient values between the two types of regimes.

(3) To test for the existence of this difference more formally, we estimate regressions with a multiplicative dummy variable for the change in expected inflation effect, $D.\Delta EI_t$ (where d = 0 during the two money supply regimes, and 1 during the 1961-1979 interest rate regime).

The dummy variable regressions (reported last under each sub-section of Table 4) seem to indicate a significant difference in the stock return - changes in expected inflation relation in the two types of regimes. In the monthly data the difference in coefficient values is 19.62 with a t-statistic of 3.24. Furthermore, the coefficient of ΔEI_t appears to be insignificant during the money supply regimes with a value of -2.86.

In the quarterly regression we again witness a statistically significant difference in the relations between stock returns and changes in expected inflation. The difference in the coefficient values of ΔEI_t is 10.91 with a t-statistic of 2.42. However, though the coefficient value during the money supply regimes is much lower than in the interest rate regime (-3.93, which is one-fourth the interest rate regime value) it is significant.

The annual evidence does not reveal a significant difference (at the 95 percent confidence level), but the entire negative effect appears to be caused by the 1961-1979 interest rate regime. The coefficient value for the money supply regimes is positive, though indistinguishable from zero, while the difference is -5.04 with a t-statistic of -1.76.

On the whole, the U.S. data show a statistically significant difference in the magnitude of the negative relation between real stock returns and changes in expected inflation between the two types of monetary regimes. The relation is significantly stronger during the 1961-1979 interest rate regime.[14]

2. Canada

The Canadian evidence also lends support to the hypothesis of a varying relation between stock returns and changes in expected inflation. The post-war period is split into two regimes: the money supply regime of 1951-1960, and the 1961-1983 interest rate regime.

(1) The interest rate regime witnesses a significant negative stock return - changes in expected inflation relation. The coefficient estimates of ΔEI_t are -18.99 and -11.07 (with t-statistics of -2.80 and -3.01) in the monthly and quarterly regressions, respectively.

(2) Conversely, the relation is weaker during the 1951-1960 money supply regime. In the monthly regression the coefficient of ΔEI_t has a value of -4.90 (with a t-statistic of -1.72), whereas the quarterly coefficient estimate is a positive 1.427, though statistically indistinguishable from zero.

(3) The dummy variable regressions provide further evidence of differences in the relation between stock returns and changes in expected inflation in the two types of regimes. The coefficient estimates of $D.\Delta EI_t$ are 14.80 and 11.29 in the monthly and quarterly results, respectively, and both estimates are statistically significant. Moreover, the stock return - changes in expected inflation relation is insignificant in the money supply regime.

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[14] We also test for a change in the intercept and the coefficient of EI_{t-1}, but the evidence indicates that there is statistical variation in the coefficient of ΔEI_t alone.

The annual regression, however, does not provide any conclusive evidence of a difference in the coefficient estimates of ΔEI_t in the two regimes. In fact, though stock returns are negatively related to changes in expected inflation, this relation is not significant even for the entire post-war sample period.

3. United Kingdom and Germany

The results for the U.K. and Germany are not as informative as those for the U.S. and Canada. The reason is that both countries apparently witnessed the same type of monetary regime (i.e., an interest rate smoothing regime) during the entire 1957-1983 sample period.

However, the evidence does support our hypothesis that the stock return - changes in expected inflation relation should be significantly negative during interest rate regimes (Table 1).

To test whether the significant difference in the stock return - changes in expected inflation relation across monetary policy regimes is not simply a random occurrence in the U.S. and Canada, we estimate dummy variable regressions for the U.K. and Germany also. Specifically, we test for the stability of the ΔEI_t effect across sub-periods which correspond to the U.S. monetary regimes. These tests indicate no change in the relation between stock returns and changes in expected inflation in the U.K. and Germany. Furthermore, even in the case of Canada there is no evidence that this relation changed in the post-1979 period (though a change did occur in 1961 when the central bank shifted from a money supply to an interest rate regime).

Hence, the overall evidence indicates that changes in the ΔEI_t effect in the U.S. and Canada are linked to changes in monetary policy regimes.

However, a similar sub-period analysis does not appear to show a statistical difference in the money-deficit relation across regimes.[15] One possible explanation for our inability to detect such differences in the degree of debt-monetization may be the substantial noise generated in short-term base money changes by the multiplicity of the central bank's transactions in treasury securities.[16] As Geske and Roll (1983) point out, long-term increases in the Fed's holdings of treasury securities are easily associated with increases in base money, but the short-term relation is complicated by the number and complexity of the Fed's transactions.

The evidence in this paper is consistent with the above explanation. We detect a significant relation between deficits and money supply changes over the entire 30-year post-war period in all four countries. However, we are unable to pick up any significant differences in this relation across shorter sub-periods.[17]

4. SUMMARY AND CONCLUSIONS

In this paper, we analyze the impact of changes in the operational targets of the monetary authorities on stock return - changes in expected inflation relations. Post-war evidence from four developed countries--the

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[15]However, there is other evidence to suggest that, in the case of the U.S., the deficit-money supply link depends on the particular policy regime in operation. Froyen (1974) finds that the federal full employment surplus is a significant explanatory variable in the 1961-1972 period, but not in the 1953-60 subperiod. Similarly, Hamburger and Zwick (1981) find strong evidence of a relation between deficits and money growth during the 1960-74 period, but find no such link before 1960.

[16]Financial data (e.g., stock prices), on the other hand, are measured more accurately and therefore do not suffer from such measurement errors.

[17]An alternative "non-structural" approach to analyzing the deficit-money supply relation could be used [see King and Plosser (1985)]. However, this approach does not provide sufficiently powerful tests to discriminate between policy regimes which are not entirely independent.

U.S., Canada, the U.K., and Germany--reveals a significant negative relation between real stock returns and changes in expected inflation in all countries. These relations appear to be generated by a counter-cyclical monetary response (to deficits) by the central banks.

More importantly, the evidence also indicates that during the post-war period the relation between stock returns and changes in expected inflation varies depending on the operating targets of the monetary authorities. Specifically, the relation is significantly stronger during interest rate regimes (as compared to money supply regimes). Moreover, there is no change in the stock return - changes in expected inflation relation in countries which experience only one type of monetary regime during our sample period (i.e., the U.K. and Germany).

However, probably due to the noise generated by the central banks' numerous and complex transactions in treasury securities, we are unable to pick up any significant differences in the money-deficit relation across shorter sub-periods.

Appendix

Identification of monetary policy regimes

Identification of distinct monetary policy regimes (i.e., interest rate vs. money supply control periods) is not straight-forward considering the ambiguous official statements made by the monetary authorities. Therefore, we do not claim to have divided our sample into perfectly distinct sub-periods.

United States

The U.S. provides a good economic scenario in which to test our hypothesis. The post-1953 period can be divided into three sub-periods:

(1) 1953-1960: After the March 1951 Accord between the Treasury and the Federal Reserve, the Fed was apparently freed from its WW II commitment to peg interest rates. However, reviewing the role of operating guides in U.S. monetary policy, Wallich and Keier (1979) note that the ". . . support of the issues involved in treasury financings continued until nearly the end of 1952." (p. 680).

The Eisenhower administration, however, viewed inflation as the major problem and paid increasing attention to money supply. In the Spring of 1953 the FOMC ruled out using open market purchases to peg yields and declared that it would confine its transactions to very short term securities, mainly bills (the "bills only" doctrine).

In an analysis of the FOMC minutes from the 1957-1960 period Atkinson (1969) states:

> The committee's failure to specify desired interest rates is, of course, not surprising, coming after the Treasury-Federal Reserve accord and arguments surrounding the bill's only policy. In fact, a significant number of committee members adopted a definite stand against the control of interest rates as an object of policy. (p. 90).

The apparent shift from pegging interest rates to monitoring money supply leads us to classify the Eisenhower years as a 'money supply control' period. Some other researchers [e.g., Froyen (1974), Buchanan and Wagner (1977), and Hamburger and Zwick (1981)] also regard this period to be distinct from the post-1960 period.

(2) 1961-1979 (September): In 1961, the thrust of monetary policy changed. In an effort to engineer a quick recovery from the 1960-61 recession, and to keep international payments in balance, the Kennedy administration became concerned about preventing "short-term interest rates from falling out of line with rates abroad." [Economic Report of the President (1961), p. 19]. The bill's only doctrine was discontinued. Hamburger and Silber (1969) present econometric evidence which also suggests that, beginning 1961, the Fed made an attempt to reduce the variability of interest rates.

The late sixties and early seventies witnessed a shift in (the Fed's) focus toward monetary aggregates. As far as the actual implementation of monetary policy is concerned, however, a study of the FOMC's policy directives over this entire period indicates that interest rate smoothing remained the Fed's primary operational goal. Meltzer (1978) summarizes the Fed's operating objectives during this period:

> . . . the decision to announce growth rates of money (has not) reduced the attention paid to money market conditions in the United States. The Federal Reserve continues to implement policy by fixing a value of the Federal funds rate and supplying the reserves required to maintain that rate. (p. 371).

(3) 1979 (October) - 1983: On October 6, 1979, an important change occurred in the FOMC's short-run operating procedures. According to the FOMC, "greater emphasis in day-to-day operations on the supply of bank reserves and less emphasis on confining short-term fluctuations in the federal funds rate [is sought to] assure better control over the expansion of money and bank credit . . . ." [Announcements (1979), p. 830].

Following this announcement, policy directives have witnessed two major changes: (i) there no longer is a specific target for the federal funds rate but it is allowed to fluctuate within a reasonably broad range, and (ii) new directives for short-term growth rates of monetary aggregates specify either particular growth rates or very narrow ranges.

Hence, there has been a reversal in the roles of the two potential operating targets of monetary policy; money supply, not interest rates, is now the primary target.

Canada

Canada has also experienced a change in monetary regime. We divide the 1951-1983 period into two sub-periods:

(1) 1951-1960: The pre-1961 period was one during which the Bank of Canada maintained that the "primary function of a central bank is to regulate the total quantity of money." [Annual Report (1959), p. 3]. There are numerous other official references, especially during the 1956-1960 period, to money supply as the target of monetary policy. Thus, following Schwartz (1969) and Pesando and Smith (1973), we view 1951-1960 as a money supply control period.

(2) 1961-1983: The appointment of a new governor in 1961 brought about an important change in the stance of monetary policy. According to Pesando and Smith (1973): "The 'quantity theory' approach, with its almost exclusive emphasis on the money supply, was replaced by a 'credit conditions' or 'tone of the market' approach which focused on interest rates, credit conditions and chartered bank liquidity." (pp. 83-84).

After 1961, annual reports make frequent references to interest rates and credit conditions, in contrast to money supply, as the primary focus of

monetary policy. In September 1982, Governor Bouey (1982) explained the bank's current philosophy:

> . . . interest rates constitute the cutting edge of monetary policy. The main policy problem has thus always been seen, and is still seen, as how to come to judgements about the direction and extent of the influence that the central bank should exert on the path of short-term interest rates. (p. 6).

Thus, the 1961-1983 period can be regarded as a period of interest rate smoothing.

United Kingdom and Germany

Unfortunately, both the U.K. and Germany have experienced no change in monetary policy regime over our sample period (1957-1983); they have concentrated on interest rate smoothing policies. In the U.K., the Radcliffe Committee insisted on "the structure of interest rates rather than some notion of the 'supply of money' as the center-piece of monetary action."

Coleby (1982) provides an indication of the central bank's continued adherence to an interest rate policy:

> The wide ranging debate in the United Kingdom . . . left the bank unpersuaded that there would be any advantage in replacing its approach to setting interest rate objectives by the more direct control of quantity--some form of monetary base; and wholly convinced that no practical basis existed for the early adoption of such a system. (p. 214).

In Germany, on the other hand, interest rates were controlled till 1967. The decontrol of interest rates, brought about by the Interest Rate Order, did not seem to alter the effectiveness of the Bundersbank's interest rate policy. As Schlesinger and Bockelmann (1973) conclude:

> . . . even without controls, the central bank's interest rates together with its liquidity policy largely determine the pattern of interest rates in the economy, just as, conversely, the former controls could in practice only be made effective to the extent that they were in harmony with the banks' liquidity position. (p. 177).

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Table 1

Quarterly Estimates of Real Stock Returns-Inflation Regressions for the Post-war Period.

$$RRS_t = \alpha + \beta_1 EI_{t-1} + \beta_2 \Delta EI_t + \eta_t .^{a}$$

	Country and Time Period	α	β_1	β_2	$\bar{R}^{2\,b}$	$s(\eta)^{c}$	$\hat{\rho}_1{}^{d}$	$\hat{\rho}_2$	$\hat{\rho}_3$	$\hat{\rho}_4$
(I)	United States (1953-1983)									
		0.039 (3.43)[e]	-2.272 (-2.98)	-6.201 (-3.63)	0.12	0.0778	0.11	-0.12	-0.06	0.00
(II)	Canada (1952-1983)									
		0.023 (2.11)	-1.955 (-2.55)	-4.972 (-2.39)	0.06	0.0773	0.13	-0.04	0.03	-0.04
(III)	United Kingdom (1958-1983)									
		0.027 (1.70)	-1.372 (-2.05)	-4.479 (-1.91)	0.05	0.0920	0.30	-0.03	0.11	-0.14
(IV)	Germany (1958-1983)									
		0.047 (2.79)	-5.023 (-3.01)	-6.144 (-3.04)	0.10	0.0786	0.30	0.05	0.20	0.16

Notes:

[a] RRS_t = real stock returns (continuously compounded); EI_{t-1} = expected inflation (at t-1) for period t; ΔEI_t = change in expected inflation from period t-1 to t.

[b] $\bar{R}^2$ = coefficient of determination;

[c] $s(\eta)$ = standard error of regression residuals.

[d] $\hat{\rho}_t$ = residual autocorrelation at lag t.

[e] T-statistics are in parentheses.

Table 2

Estimates of Stock Return-Inflation Regressions: Comparison of Quarterly OLS and SURM Results for the Period 1958-1983.

$$RRS_t = \alpha + \beta_1 EI_{t-1} + \beta_2 \Delta EI_t + \eta_t .^{a}$$

Country and Time Period	α	β_1	β_2	$s(\eta)^b$
(I) OLS regressions				
(1) United States	0.039	-2.192	-5.989	0.0817
	(2.86)[c]	(-2.53)	(-3.29)	
(2) Canada	0.028	-1.852	-7.589	0.0807
	(1.93)	(-2.01)	(-2.81)	
(3) United Kingdom	0.030	-1.427	-4.673	0.0907
	(1.93)	(-2.18)	(-2.03)	
(4) Germany	0.047	-4.677	-6.153	0.0797
	(2.79)	(-2.78)	(-3.00)	
(II) SURM regressions				
(1) United States	0.035	-1.875	-3.273	0.0814
	(2.99)	(-2.80)	(-3.06)	
(2) Canada	0.029	-1.955	-4.123	0.0802
	(2.37)	(-2.71)	(-2.49)	
(3) United Kingdom	0.028	-1.299	-3.698	0.0895
	(1.90)	(-2.19)	(-1.88)	
(4) Germany	0.044	-4.318	-5.115	0.0786
	(2.73)	(-2.73)	(-2.70)	

Notes:

[a] RRS_t = real stock returns (continuously compounded); EI_{t-1} = expected inflation (at t-1) for period t; ΔEI_t = change in expected inflation from period t-1 to t.

[b] $s(\eta)$ = standard error of regression residuals.

[c] T-Statistics are in parentheses.

Table 3

Estimates of Real Stock Return-Inflation Regressions for the United States and Canada in Different Post-war Monetary Regimes.

$$RRS_t = \alpha + \beta_1 EI_{t-1} + \beta_2 \Delta EI_t + \beta_3 D.\Delta EI_t + \eta_t .^{a}$$

	Country and Time Period	α	β_1	β_2	β_3	$\bar{R}^{2\,b}$	$s(\eta)^{c}$	$\hat{\rho}_1{}^{d}$	$\hat{\rho}_2$	$\hat{\rho}_3$	$\hat{\rho}_4$
(I)	United States (1953-1983)										
	(1) Monthly										
	(i) 1953.03-1960.12 (n=94)	0.023 (4.56)[e]	-11.565 (-3.27)	-6.203 (-0.68)	-	0.05	0.0318	-0.01	-0.02	0.02	0.12
	(ii) 1961.01-1979.09 (n=225)	0.013 (2.56)	-2.738 (-2.40)	-22.127 (-3.73)	-	0.07	0.0414	0.03	-0.04	0.03	0.07
	(iii) 1979.10-1983.11 (n=50)	0.048 (3.41)	-6.778 (-3.26)	-4.502 (-1.79)	-	0.15	0.0439	-0.04	-0.02	-0.01	0.05
	(iv) Dummy Variable Regression	0.016 (4.88)	-3.213 (-4.22)	-2.864 (-1.37)	-19.623 (-3.24)	0.07	0.0398	0.04	-0.03	0.03	0.07
	(2) Quarterly										
	(i) 1953.03-1960.04 (n=30)	0.071 (4.32)	-10.124 (-2.85)	-0.703 (-0.12)	-	0.19	0.0571	-0.08	0.15	-0.14	-0.01
	(ii) 1961.01-1979.03 (n=75)	0.038 (2.02)	-2.370 (-1.75)	-14.325 (-3.10)	-	0.11	0.0834	0.06	-0.25	-0.06	0.02
	(iii) 1979.04-1983.03 (n=16)	0.134 (3.28)	-6.350 (-3.09)	-5.752 (-3.29)	-	0.27	0.0688	0.31	0.36	-0.30	-0.14
	(iv) Dummy Variable Regression	0.049 (4.20)	-2.988 (-3.39)	-3.913 (-2.41)	-10.916 (-2.42)	0.15	0.0770	0.12	-0.12	-0.12	-0.08

Table 3
(Continued)

Estimates of Real Stock Return-Inflation Regressions for the United States and Canada in Different Post-war Monetary Regimes.

$$RRS_t = \alpha + \beta_1 EI_{t-1} + \beta_2 \Delta EI_t + \beta_3 D.\Delta EI_t + \eta_t.$$

	Country and Time Period	α	β_1	β_2	β_3	R	s(η)	$\hat{\rho}_1$	$\hat{\rho}_2$	$\hat{\rho}_3$	$\hat{\rho}_4$
	(3) Annual										
	Dummy Variable Regression	0.146 (2.74)	-1.742 (-1.64)	0.355 (0.17)	-5.042 (-1.76)	0.16	0.1709	-0.07	-0.24	0.08	0.30
(II)	Canada (1952-1983)										
	(1) Monthly										
	(i) 1952.01-1960.12 (n=108)	0.007 (1.75)	-3.389 (-1.48)	-4.900 (-1.72)	-	0.02	0.0344	0.23	0.02	-0.01	0.01
	(ii) 1961.01-1983.11 (n=275)	0.010 (1.66)	-1.849 (-1.74)	-18.990 (-2.80)	-	0.03	0.0506	-0.03	-0.08	0.09	0.00
	(iii) Dummy Variable Regression	0.008 (2.06)	-1.611 (-2.06)	-3.953 (-1.12)	-14.797 (-2.08)	0.03	0.0466	0.02	-0.06	0.08	0.01
	(2) Quarterly										
	(i) 1952.01-1960.04 (n=36)	0.011 (0.52)	-3.360 (-0.01)	1.427 (0.31)	-	0.00	0.0689	0.14	0.16	0.06	-0.08
	(ii) 1961.01-1983.03 (n=91)	0.031 (1.82)	-1.958 (-1.92)	-11.071 (-3.01)	-	0.09	0.0824	0.17	-0.06	-0.01	-0.08
	(iii) Dummy Variable Regression	0.022 (1.95)	-1.494 (-1.91)	0.927 (0.15)	-11.295 (-2.29)	0.07	0.0785	0.17	-0.01	0.00	-0.09

Table 3
(Continued)

Estimates of Real Stock Return - Inflation Regressions for the United States and Canada in Different Post-war Monetary Regimes.

$$RRS_t = \alpha + \beta_1 EI_{t-1} + \beta_2 \Delta EI_t + \beta_3 D.\Delta EI_t + \eta_t.$$

Country and Time Period	α	β_1	β_2	β_3	$\bar{R}^2$	s(η)	$\hat{\rho}_1$	$\hat{\rho}_2$	$\hat{\rho}_3$	$\hat{\rho}_4$
(3) Annual										
Dummy Variable Regression	0.086 (1.64)	-1.588 (-1.66)	-0.272 (-0.15)	-1.619 (-0.64)	0.01	0.1671	-0.05	-0.37	0.03	0.16

Notes:

[a] RRS_t = real stock returns (continuously compounded); EI_{t-1} = expected inflation (at t-1) for period t; ΔEI_t = change in expected inflation from t-1 to t; $D.\Delta EI_t$ = multiplicative dummy variable, D=0 during money supply regimes and D=1 during interest rate regimes.

[b] $\bar{R}^2$ = coefficient of determination.

[c] s(η) = standard error of regression residuals.

[d] $\hat{\rho}_t$ = residual autocorrelation at lag t.

[e] T-statistics are in parentheses.