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STOCK RETURNS, INFLATIONARY EXPECTATIONS, AND REAL ACTIVITY: NEW EVIDENCE

by

Bjorn Wahlroos*
and
Tom Berglund**

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*J. L. Kellogg Graduate School of Management, Northwestern University, 2001 Sheridan Road, Evanston, Illinois 60201.

**Swedish School of Economics and Business Administration, Helsinki, Finland.

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1. Introduction

Irving Fisher (1930) showed that any one-period nominal interest rate can be broken into an expected real return and an expected inflation component. Fama and Schwert (1977) note that the Fisher hypothesis can be generalized to all assets traded in efficient markets. The generalized Fisher hypothesis for asset markets is therefore one of the familiar joint type stating that (a) the market is efficient, and (b) expected real returns to common stocks are independent of the inflation rate. This hypothesis is frequently (e.g., Gultekin, 1983a) tested in the form:

$$(1) \qquad R_t = \alpha + \beta E(\pi_t | \phi_{t-1}) + \varepsilon_t$$

where R_t is the nominal return to the market portfolio of risky assets, π_t is the inflation rate, E is the expectations operator, and ϕ_{t-1} the information set available to investors at the end of t - 1. An estimate of β insignificantly different from unity would imply a one-to-one relationship between nominal stock returns and expected inflation and hence be consistent with the Fisher hypothesis. It should be noted that the assertion that real rates are constant or independent of inflation obviates the need for a general equilibrium model of interest rates.

As in Fama-Schwert (1977), Gultekin (1983a), and Solnik (1983), interest can also be focused on expected and unexpected components of the inflation rate and their influence on stock returns. To this end, write

$$(2) \qquad R_t = \alpha + \beta_1 E(\pi_t | \phi_{t-1}) + \beta_2 [\pi_t - E(\pi_t | \phi_{t-1})] + \eta_t,$$

where unexpected inflation is simply defined as the realization π_t minus the expectation. Again, β_1 should be statistically indistinguishable from unity. The sign of β_2 is dependent on the specific type of asset analyzed (Fama-Schwert, 1977, p. 117). Constituting claims to real assets, stocks have traditionally been considered good hedges against unanticipated inflation. If that is indeed the case we would expect $\beta_2 = 1$.

Several recent studies have investigated relationships like those of (1) and (2). Nelson (1976), Bodie (1976), Fama and Schwert (1977) and others show that the relation between stock returns and inflation in the U.S. does not support the Fisher hypothesis and is in fact strongly negative. International evidence by Gultekin (1983a) and Solnik (1983) support the same conclusion.

The discussion now seems to have turned from whether stock returns are negatively correlated to expected inflation, to why they are. Several rival hypotheses have been suggested by Lintner (1975), Modigliani and Cohn (1979), Feldstein (1980a) and (1980b), Fama (1981), and Geske and Roll (1983). Of these, the Lintner, Modigliani and Cohn explanations require assumptions of investor irrationality.[1] The Geske-Roll argument deals only with relationships between stock returns on one hand and unanticipated inflation and beginning of the period interest rates on the other hand, neither of which is essential to this paper.[2]

Feldstein (1980a and 1980b) shows that, because of existing tax rules like historic cost depreciation and taxation of nominal capital gains, a permanent increase in expected inflation will, through its increasing effect on the present value of the firm's and its owners' future tax liabilities, depress share prices of affected firms.

Fama (1981), on the other hand, suggests that the stock return-inflation correlation is spurious in nature, reflecting only the mechanics of money demand, real activity and inflation imbedded in the quantity theory. In the expectation of a surge (drop) in real activity due to a positive (negative) real shock, stock returns will increase (decrease). Simultaneously, the forthcoming increase (decrease) in real activity will serve to increase (decrease) money demand, which under a central bank policy of stable money supply growth will reduce (increase) the inflation rate. Stock returns and expected inflation will hence be negatively correlated although that correlation is devoid of any causation.

The object of the present paper is twofold. First, we test the Fisher independence hypothesis on monthly Finnish data for the period January 1969 through December 1982. The results firmly reject the hypothesis. Quite independently of the method by which expectations are proxied, nominal stock returns are strongly negatively related to expected inflation. Real stock returns are found to depend negatively on unexpected inflation as well.

Second, the Fama (1981) explanation to this phenomenon is investigated. We are able to find unambiguous support for every separate step of his argument. Most notably, stock prices do predict future increases in real activity, as does inflation, albeit with the opposite sign. However, the Fama hypothesis fails to pass its final test. When both expected inflation and future real activity are used to explain stock returns, the former turns out to be the significant determinant. This conclusion remains valid independently of whether monthly or quarterly data is used and whether industrial production or GNP is used to measure real activity.

It is suggested that this failure of the Fama model may be due to foreign exchange regulation. Most smaller European central banks have pegged the value of their currency to basket indeces. The administrative lags inherent in such a system produce foreign exchange disequilibria that can be predicted by the inflation rate. The (expected) inflation rate might therefore proxy for (expected) losses incurred by incorporated firms due to an overvalued currency. This hypothesis is, however, also rejected by the data. Stock returns are not responsive to measures of future foreign exchange disequilibria.

The paper is organized as follows: In the next section the data on which the analysis is to be based is presented. Section 3 contains several tests of the Fisher hypothesis with different expectational assumptions. Section 4 in turn addresses the question why stock returns are negatively linked to expected inflation. Section 5 discusses the results and concludes the paper.

2. The Data

In the period covered by this study, January 1969 through December 1982, the Helsinki Stock Exchange (HESE) listed between 53 and 66 stocks. Rates of return on these stocks are computed from the WI value weighted market index, described in greater detail in Berglund, Wahlroos and Grandell (1983). That index is the value-weighted sum of individual stock return indices based on the average trading price for the day, or in its absence, on the bid price, corrected for dividends, splits, stock dividends and new issues. The corrections are based on the assumption that all proceeds are reinvested into the stock from which they derive at no transaction cost. Market rate of return figures are logarithmic price differentials of the WI-market index.

Inflation is measured by monthly changes in the consumer price index (CPI). Exploratory analyses indicated, as do the results of Gultekin (1983b) for American data, that different measures of inflation produce almost identical results with respect to stock returns. The money stock is measured by M_1 as reported in the Bank of Finland Monthly Bulletin, and by M_1 plus time deposits (M_2).

Monthly data on real Finnish output are scarce. GNP data are not available at time periods shorter than one quarter. Of the available monthly series proxying real output, unadjusted volume of industrial production, seasonally adjusted volume of industrial production, and survey-based unemployment data, we chose the seasonally-adjusted industrial production series. A quarterly data set including GNP-growth as well as industrial output was, however, also established. Control runs on quarterly data, some of which are reported on in table 9, indicated that seasonally adjusted monthly industrial output figures proxy GNP-growth quite accurately.

Table 1 presents summary statistics and estimates of the first twelve autocorrelations for our major time series. Stock returns exhibit significant first and second order autocorrelation. By comparison, 19 out of the 26 stock markets considered by Gultekin (1983a) exhibited significant first order and 7 of these significant second order autocorrelation.[3] This phenomenon has largely been ascribed to a Fisher-effect due to thin trading (Fisher, 1966).

INSERT TABLE 1 HERE

Inflation rates are highly autocorrelated in Finland just as in the majority of the countries studied by Gultekin (1983a). Money and output growth figures are clearly less, if at all, autocorrelated. The highly significant ρ_{12}-value in both money stock measures reflects seasonality, specifically a December-boom which was particularly pronounced in the years 1969 through 1976. The negative first order autocorrelation in M_1 is largely a reflection of a January rebound.

3. Stock Returns and Inflationary Expectations

The literature contains four major approaches to the measurement of inflationary expectations, namely, use of (1) contemporary inflation (Gultekin (1983a)), (2) estimates from ARIMA-models (Bodie (1976) Nelson (1976), and Gultekin (1983a)), (3) short-term interest rates on default-free discount bonds (Fama-Schwert (1977), Fama (1981), Solnik (1983) and Gultekin (1983a)), and (4) estimates from money-supply and real activity-based prediction models (French, Ruback and Schwert (1983)). Of these, the Fama (1975) method of measuring expected inflation from treasury bill rates cannot, for lack of openly traded short-term riskfree monetary instruments, be applied to the Finnish case.[4] In what follows, the relationship between stock returns and inflation will therefore be analyzed using only the remaining three methods of proxying expectations.

Table 2 reports on regressions of stock returns on contemporaneous and lagged inflation rates over the January 1970 through December 1982 period. Regressions on contemporary realizations are based on an assumption of rational expectations.[5] Contrary to the Fisher hypothesis, nominal stock returns turn out to depend significantly (5%) negatively on contemporaneous inflation rates. The positive serial correlation in the stock return data produces quite low Durbin-Watson statistics. An effort to adjust the regressions for first order serial correlation did not, however, change the conclusion with respect to β_1.[6]

INSERT TABLE 2 HERE

Rows 2 through 7 of table 2 present regressions of stock returns on contemporaneous and lagged inflation rates. The sum of the slope coefficients, the explanatory power of the regression and the DW-statistic grow with the number of lags included. F-tests reject the hypothesis that all β are zero on the one-percent level throughout. These results also appear at odds with the Fisher hypothesis.

Next, we turn to Box-Jenkins estimates of ARIMA-models of inflation, frequently used to proxy inflationary expectations in economic models. In addition to providing a rationale[7] for the formation of expectations, they permit a decomposition of the inflation rate into expected (estimates) and unexpected (forecast errors) components.[8]

INSERT TABLE 3 HERE

Table 3 summarizes the outcome of some experiments with ARIMA expectation models on January 1970-December 1982 data. Contrary to Gultekin (1983a, pp. 56-59), we find results that are highly robust to the ARIMA-model chosen, especially where the model contains a MA1-parameter. Apparently, this difference is due to the different time periods studied. Our data set does not include the apparent structural shift in the inflationary process which occured not only in Finland, but also in most of the other countries studied by Gultekin (1983a) in the late 1960s.

Regressing stock returns on the ARIMA estimates and the forecast errors, we obtain negative coefficient signs for both expected and unexpected inflation. Coefficients for unexpected inflation are not, however, significantly different from zero. DW-statistics, especially for ARIMA (1,0,0) expectations, hint at some autocorrelation. Here and in what follows we will subject our results to an elementary test of robustness by controlling for first order autocorrelation by the introduction of R_{t-1} into the regression. In the present case, this procedure does not change the outcome appreciably. Indeed, first order autocorrelation as measured by β_3 is insignificant (5%) in all cases where the expectations model includes a MA1-parameter. Like the previous ones, these results firmly reject the Fisher hypothesis.

Since there are some problems associated with the assumptions needed to derive ARIMA-type expectations formation, we tested yet another expectational proxy suggested by Fama (1981) and French-Ruback-Schwert (1983). Specifically, we will consider the expectations model

$$(3) \qquad E(\pi_t) = \alpha + \sum_{i=1}^{24} \beta_i M_{Nt-1} + \sum_{j=1}^{6} \gamma_j T_{t-j} + \sum_{k=1}^{3} \delta_k \pi_{t-k} + \phi D_t + \varepsilon_t,$$

where M_N is the appropriate money stock growth measure, T is the growth rate of real activity, and D_t is a dummy equalling one in the month of December and zero otherwise. This equation contains several expectational models as special cases. If all βs, γs and ϕ are zero, an AR(3) model is correct; if all γs, δs and ϕ are zero, and $\Sigma\beta$ equals unity, a Friedman-type serially uncorrelated inflation model with a two-year distributed lag is correct; if all δs are zero, a serially uncorrelated money-supply model with demand adjustment is correct.

Table 4 reports on estimation of (3) from M_1 and M_2 money stock growth data, and on subsequent tests of the Fisher hypothesis on monthly data for the January 1969 through December 1982 period.[9] F-tests reject the null hypothesis that all slope coefficients of the expectations model equal zero on the five percent level in every case. The true money-stock measure seems to lie somewhere between M_1 and M_2 since for the first two regressions, the former receives a $\Sigma\beta < 1$ and the latter a $\Sigma\beta > 1$. The pure AR(3) model of inflation is firmly rejected by our results. DW-statistics indicate only weak autocorrelation and δ-coefficients receive statistically insignificant values.

INSERT TABLE 4 HERE

The regressions reported on in panel B of table 4 are very similar in outcome to those based on ARIMA-expectations. Once again the Fisher hypothesis is firmly rejected. Judged by r^2s, t-statistics for β_1, or F-statistics for the regression, the negative relationship, however, appears slightly weaker than in the previous table. Indeed, the expectations model of equation (3), contrary to an ARIMA model, is not able to eliminate the first order autocorrelation from the residuals of the stock return-inflation regression.

Our money-supply based expectations model may, however, just as the French-Ruback-Schwert (1983) model, be criticized for not properly addressing a potential seasonality problem in the data. Money growth rates are typically, as we noted above, seasonal, whereas inflation rates are not. Introduction of a December dummy may account for some--although probably not all--of this. In the regressions of table 5 we deal with this problem by imposing a restriction on the lag structure of (3) by summing over it prior to regression. Bi-annual and semiannual growth rates of the money stock and industrial output are deseasonalized variables that are likely to produce good short-term inflation forecasts.[10] Accordingly, in table 5, expectations are given by

$$(4) \qquad E(\pi_t) = \alpha + \beta \sum_{i=1}^{24} M_{t-1} + \gamma \sum_{j=1}^{6} T_{t-j} + \sum_{k=1}^{3} \delta_k \pi_{t-k} + \delta D_t + \varepsilon_t$$

The regression model (4) succeeds in that it, in addition to assigning the correct signs to the coefficients of all component variables and yielding β-estimates that, for M_2 are very close to unity indeed,[11] transforms the highly autocorrelated inflation rates into residuals which, even without the introduction of the AR(3) correction, are indistinguishable from white noise. However, December dummies remain significant.

INSERT TABLE 5 HERE

Turning to panel B of the same table we find that, if anything, the case for rejection of the Fisher hypothesis has been strengthened by the improvements in the expectations model. All test statistics for the regression have improved while there has been no appreciable change in the properties of the residuals in panel B of table 5 as compared to those of table 4.

The conclusion that the Fisher hypothesis must be rejected is thus unavoidable. Nominal stock returns, expected to exhibit a one-to-one positive dependence on the expected inflation rate, depend negatively on expected inflation rates, apparently independently of how expectations are proxied. The magnitude of the effect of inflation on stock returns found in the Finnish data is slightly smaller than the negative five-to-one effect reported by Fama-Schwert (1977) for the United States. Our estimates vary from slightly more than minus unity in the contemporaneous inflation case to -4.5 in the ARIMA-case with the money growth models producing slope estimates of -1.7 to -3.5.

4. Why Stock Returns are Negatively Related to Inflation

In the early monetarist fashion, Irving Fisher believed in separability of the real and monetary sectors of the economy. His hypothesis, stated in real terms, holds that real stock returns are determined by real factors such as the time preferences of investors and the productivity of capital, and is hence independent of monetary variables such as inflation. So far we have shown that nominal stock returns depend negatively on inflation. It follows, and this will be shown below, that real returns, rather than being independent of, depend strongly negatively on inflation.

Two explanations to this puzzling phenomenon were briefly surveyed above. This section is concerned with the explanation provided by Fama (1981), that the negative relations between stock returns and inflation are proxying for positive relations between stock returns and real variables. They are induced by negative relations between inflation and real activity.

More specifically, controlling for the money supply, a simple rational expectations version of the quantity theory predicts that higher expected rates of real activity growth are associated with reductions in contemporary inflation rates. That is, under conditions of a central bank policy of either stable money growth or money growth that varies insufficiently with changes in real activity, rational economic agents will adjust their prices upwards in the expectation of a slump, and downward in the expectation of a boom in economic activity. Stock returns will, however, exhibit changes in the opposite directions. Hence, inflation in equations (1) and (2) may simply proxy for real activity.

To test this proposition, we shall first document the steps of the argument by demonstrating (1) that stock returns predict changes in real activity, and (2) that inflation rates are negatively related to future growth in economic activity. The final and decisive test will then involve relating real stock returns to combinations of real variables and measures of expected and unexpected inflation. If the Fama hypothesis holds true we would, in line with the Fisher hypothesis, expect real stock returns to be independent of expected inflation once its relation to future real activity has been controlled for.

A. Stock Returns and Future Real Activity

Table 6 documents a strong positive relation between both real and nominal stock returns and future real activity. The independent variable in the regressions is the growth of industrial production 1,2,...,8 quarters ahead of the month in which the stock market return is recorded. What we find is that real activity at leads of 3 to 6 quarters is highly significant in explaining stock returns. Since the Fisher effect in the market index produces first-order autocorrelation, which in no way is addressed in our model, it is not surprising to find that ρ_1 is significant in all regressions with the exception of the 3 and 4 quarter leads for nominal returns. However, adjustment for this did not appreciably change the magnitude or the t-statistic of the slope coefficient.

INSERT TABLE 6 HERE

B. Inflation and Future Real Activity

Table 7 reports on regressions of inflation rates on future growth in real activity. Quite in line with the money demand/quantity theory-based prediction, current inflation rates are negatively linked to future real activity. Inflation rates seem to predict changes in real activity at leads of 4 to 8 quarters.

INSERT TABLE 7 HERE

Autocorrelation will necessarily become a problem when dealing with inflation and especially with expected inflation, particularly where the expectations model contains an autoregressive component. When the number of monthly leads included in ΣT is less than 24, the inflation regressions contain significantly autocorrelated residuals. At n = 24, however, the highly autocorrelated inflation rates are transformed into serially uncorrelated residuals.

This is not the case where expected inflation is concerned. DW-statistics clearly reflect the fact that residuals are still serially correlated at very high orders. Residual autocorrelation in panel B of table 7 is actually much stronger than in the original inflation series itself. Efforts at adjusting for this were not entirely successful. However, the slope coefficient of the regression remained significantly negative throughout these experiments.

C. Stock Returns, Inflation, and Real Activity

Having established that the premises of the Fama (1981) proxy-effect argument on stock returns and inflation are essentially correct, we now turn to the decisive test. To recapitulate, if it is true that expected inflation only proxies for real activity in the explanation of real stock returns, controlling for the latter should leave the returns independent of inflation.

INSERT TABLE 8 HERE

Table 8 reports a number of test of this proposition. In the first row of each of the panels real stock returns are regressed on expected (and unexpected) inflation. Indepedently of the expectation model we find a very strong negative relation, not only between real stock returns and expected inflation but also between real stock returns and unexpected inflation. The latter relation, found in American data as well (Fama-Schwert (1977), French-Ruback-Schwert (1983)), has mostly been considered somewhat less anomalous than the rejection of the Fisher hypothesis.

Introduction of leaded industrial outputs as measures of future real activity into the regression changes the outcome with respect to the slope coefficient β_1 associated with expected inflation very little. Even where real activity at a 12-month lead is assigned a significantly positive (5%) coefficient in panels A and C, the reduction in magnitude and significnace of β_1 is miniscule. Where inflationary expectations are ARIMA based they completely dominate the regression. Real activity receives a statistically insignificant coefficient at all leads while both expected and unexpected inflation remain highly significant in explaining stock returns.

Use of the seasonally adjusted industrial output figures to proxy real activity may, however, be criticized for at least two reasons: (a) industrial output, although it typically correlates with output in other sectors, takes no explicit account of financial, agricultural, trade, and service activity; (b) the seasonal adjustment contained in the data may actually be more harmful than beneficial. To study the robustness of our conclusions we reran the regressions of table 8 on quarterly data including the change in real GNP as an alternative measure of real activity.

INSERT TABLE 9 HERE

The results are contained in table 9. In panels A and B, where regressions are based on contemporaneous and ARIMA-expected inflation, results for the two measures of real activity are almost identical. Moreover, they do not differ appreciably from corresponding results based on monthly data. In panel C the impact of expected inflation on stock returns becomes statistically insignificant when real activity at a four-quarter lead is controlled for. However, real activity itself will not be statistically significant (5%) either, pointing to some obvious problems of multicollinearity.

It therefore seems that the Fama (1981) proposition cannot explain all of the surprisingly strong negative relationship between real stock returns and inflation in our data. This outcome seems to contain a suggestion that the final explanation to that apparent anomaly must be composed of several parts.

5. Summary and Discussion

The object of this paper was (a) to study the relationships between stock returns and expected and unexpected inflation, thereby testing the generalized Fisher hypothesis that real stock returns are independent of inflationary expectations, and (b) to test the money demand based proxy effect explanation for the seemingly anomalous observed negative correlations between stock returns and inflation. Our results firmly reject the Fisher hypothesis. Instead of finding the predicted one-to-one positive relation between nominal stock returns and expected inflation, we record a highly significant negative relation. This relation furthermore appears quite robust to changes in the underlying expectations model.

In an effort to explain this result as a proxy effect, we showed that real stock returns and inflation are indeed both linked to future real economic activity. This means that the expected inflation rate must, to some extent, proxy for real activity. However, once that effect is controlled for by the introduction of measures of future real activity, expected inflation rates do not receive insignificant coefficient values in the real stock return equation. Instead, they remain highly significantly negative. Again, this result is robust both to changes in the expectations model and, it seems, to the time period studied, since experiments using only parts of the data yielded essentially similar results.

This must be taken as an indication that the Fama proxy effect hypothesis, at best, is only part of the final explanation to the negative stock return-inflation relation. In the introductory section of this paper we indicated that imperfections in the foreign exchange market, or more specifically, the pegging of most of the world's minor currencies to basket indeces, might account for some of the observed correlation.[12] The stock market may interpret an increase in the expected rate of inflation as a signal of forthcoming overevaluation of the currency.[13] Such an overevaluation, in turn, would prove detrimental to the short-run profits of firms that face international competition in their (domestic or export) markets.

The data, however, reject this hypothesis rather firmly. In table 10 the results of regressions of stock returns on two different measures of future foreign exchange disequilibrium are reported. In panel A disequilibrium is measured by the average visible trade balance,[14] and in panel B by the change in the central bank's foreign exchange reserve. In both cases positive slope coefficients would be consistent with the signal hypothesis.

INSERT TABLE 10 HERE

β's are, however, insignificantly negative at leads of 12 to 24 months. At shorter leads they are zero. Further experiments where foreign exchange disequilibrium measures were introduced into regressions such as reported on in tables 8 and 9, provided additional support for a rejection of the signal hypothesis. Disequilibrium measures were consistently assigned insignificantly negative coefficients and appeared to strengthen the negative relationship between real stock returns and inflation rather than weakening it.

We must therefore conclude that none of the proxy effect hypotheses studied are able to explain the strong negative relationship between real stock returns and inflation in its entirety. The Fama proposition is, however, likely to be part of the final explanation. Failures, such as the present one, to reduce the anomaly to a money-supply or foreign exchange related phenomenon, would seem to suggest that the answer is likely to be related to imperfections in some other non-market process. The Feldstein (1980a and 1980b) nominal taxation argument would therefore seem worthy of closer (empirical) investigation.

Table 1. Means, standard deviations and autocorrelations of monthly data January 1969 through December 1982.

Variable	Symbol	Mean	σ	ρ_1	ρ_2	ρ_3	ρ_4	ρ_5	ρ_6	ρ_7	ρ_8	ρ_9	ρ_{10}	ρ_{11}	ρ_{12}	k
Nominal† Stock Returns	R	.0122	.0353	.253*	.184*	.134	.052	.174*	.221*	.266*	.101	.165*	-.004	.174*	.232*	-1.52
Money Stock	M1	.0123	.0499	-.271*	-.084	.025	-.023	-.144	.272*	-.102	.029	-.096	-.041	-.251*	.435*	2.09
	M2	.0112	.0131	-.071	-.076	-.175*	-.033	-.076	.181*	-.066	.011	-.214*	-.076	-.089	.689*	.34
Inflation	π	.0079	.0062	.266*	.283*	.189*	.174*	.224*	.327*	.210*	.156	.293*	.099	.239*	.327*	-2.38
Output	T	.0016	.0446	-.148	-.320*	.002	.101	-.055	.022	-.103	-.007	.066	-.025	-.127	.283*	1.47

†January 1970 through December 1982.

*More than two standard deviations left or right of the expected value under the hypothesis that the true autocorrelation is zero.

k—k statistic [(Observed-Expected)/Std] for runs over and under the mean.

Table 2. Stock returns, contemporaneous and lagged inflation rates. OLS-estimates January 1970 through December 1982. (t-statistics in parentheses.)

$$R_t = \alpha + \sum_{i=0}^{n} \beta_i \pi_{t-n} + \varepsilon_t$$

Row	α	π_t β_0	π_{t-1} β_1	π_{t-2} β_2	π_{t-3} β_3	π_{t-4} β_4	π_{t-5} β_5	π_{t-6} β_6	r^2	F	DW	$\Sigma\beta$
1	.021	-.105							.03	5.22	1.59	-1.05
	(4.41)	(2.28)										
2	.030	-.75	-1.33						.08	6.95	1.58	-2.08
	(5.36)	(1.62)	(2.90)									
3	.031	-.70	-1.29	-.22					.08	4.68	1.59	-2.21
	(5.12)	(1.48)	(2.75)	(.47)								
4	.034	-.66	-1.15	-.10	-.67				.10	4.04	1.63	-2.58
	(5.31)	(1.41)	(2.41)	(.20)	(1.43)							
5	.039	-.61	-1.09	.15	-.45	-1.23			.14	4.80	1.61	-3.23
	(5.99)	(1.32)	(2.32)	(.31)	(.96)	(2.68)						
6	.039	-.61	-1.09	.15	-.45	-1.23	-.00		.14	3.97	1.61	-3.23
	(5.75)	(1.31)	(2.31)	(.31)	(.94)	(2.63)	(.00)					
7	.042	-.36	-1.01	.14	-.42	-1.06	-.14	-.97	.16	4.07	1.66	-3.82
	(6.09)	(.75)	(2.16)	(.31)	(.90)	(2.24)	(.29)	(2.04)				

Table 3. Stock returns, expected and unexpected inflation, ARIMA expectation models January 1970 through December 1982. In Panel A, figures in parentheses are standard deviations of ARIMA parameter estimates; in Panel B they are t-statistics. $\delta(\mu)$ denotes standard deviation of residuals of ARIMA models.

Panel A: ARIMA Expecations Model						Panel B: Stock Returns and Inflation						
						$R_t = \alpha + \beta_1 E(\pi_t) + \beta_2 [E(\pi_t) - \pi_t] - \beta_3 R_{t-1}$						
ARIMA Model	AR1	AR2	MA1	MA2	$\delta(\mu)$	Constant α	Expected β_1	Unexpected β_2	R_{t-1} β_3	r^2	F	DW
1,0,0	.758 (.051)	–	–	–	.0070	.029 (5.32)	-.2.47 (3.66)	-.075 (1.61)	–	.081	6.70	1.58
						.025 (4.32)	-2.14 (3.17)	-.068 (1.49)	.205 (2.65)	.121	6.98	2.03
1,0,1	.998 (.001)	–	.869 (.038)	–	.0057	.048 (6.25)	-4.44 (4.98)	-.031 (.67)	–	.139	12.39	1.72
						.042 (4.92)	-3.86 (4.07)	-.034 (.74)	.136 (1.70)	.156	9.33	2.00
2,0,1	.995 (.009)	.003 (.014)	.867 (.039)	–	.0058	.048 (6.25)	-4.43 (4.97)	-.031 (.67)	–	.139	12.36	1.72
						.042 (4.91)	-3.86 (4.06)	-.035 (.74)	.136 (1.70)	.155	9.31	2.01
2,0,2	.990 (.009)	.009 (.014)	.849 (.081)	.020 (.085)	.0058	.049 (6.28)	-4.47 (5.01)	-.031 (.66)	–	.141	12.53	1.72
						.042 (4.95)	-3.89 (4.10)	-.034 (.73)	.136 (1.69)	.157	9.41	2.00

Table 4. Stock returns and inflationary expectations as given by equation (3), January 1969 through December 1982. (t-statistics in parentheses.)

Panel A: Expectations Model

$$\pi_t = \alpha + \sum_{i=1}^{24} \beta_i M_{t-i} + \sum_{j=1}^{6} \gamma_j T_{t-j} + \sum_{k=1}^{3} \delta_k \pi_{t-k} + \phi D_t$$

Panel B: Stock Returns and Inflationary Expectations

$$R_t = a + b_1 E(\pi_t) + b_2[\pi_t - E(\pi_t)] + b_3 R_{t-1}$$

	Panel A: Expectations Model										Panel B: Stock Returns and Inflationary Expectations						
Money Measure	Constant α	Money $\Sigma\beta$	Output $\Sigma\gamma$	Dummy ϕ	π_{t-1} δ_1	π_{t-2} δ_2	π_{t-3} δ_3	r^2	F	DW	Constant a	Expected b_1	Unexpected b_2	R_{t-1} b_3	r^2	F	DW
M_1	.0025	.552	–	-.0047	–	–	–	.316	2.19	1.82	.029	-1.92	-.62	–	.039	2.87	1.60
				(2.09)							(3.40)	(2.17)	(1.02)				
											.024	-1.68	-.54	.245	.099	5.10	2.15
											(2.84)	(1.95)	(.92)	(3.04)			
M_2	-.0044	1.202	–	-.0046	–	–	–	.294	1.97	1.71	.027	-1.78	-.72	–	.036	2.59	1.60
				(1.56)							(3.14)	(1.93)	(1.21)				
											.024	-1.70	-.57	.251	.098	5.07	2.16
											(2.79)	(1.90)	(.98)	(3.12)			
M_1	.0030	.511	-.085	-.0038	–	–	–	.364	2.07	1.88	.031	-2.23	-.35	–	.052	3.83	1.61
				(1.68)							(3.98)	(2.71)	(.56)				
											.026	-1.99	-.29	.241	.109	5.71	2.15
											(3.38)	(2.47)	(.48)	(3.01)			
M_2	-.0033	1.106	-.073	-.0046	–	–	–	.328	1.76	1.73	.030	-2.12	-.50	–	.045	3.33	1.60
				(1.56)							(3.68)	(2.45)	(.82)				
											.027	-2.03	-.35	.252	.108	5.64	2.17
											(3.30)	(2.41)	(.59)	(3.14)			
M_1	.0021	.342	-.069	-.0032	.033	.178	.017	.387	2.03	1.97	.031	-2.20	-.29	–	.053	3.94	1.63
				(1.38)	(.35)	(1.92)	(.19)				(4.06)	(2.77)	(.46)				
											.026	-1.90	-.28	.236	.106	5.61	2.17
											(3.35)	(2.43)	(.46)	(2.93)			
M_2	-.0026	.801	-.063	-.0038	.115	.138	-.035	.352	1.74	1.99	.031	-2.15	-.42	–	.048	3.54	1.61
				(1.29)	(1.22)	(1.46)	(.37)				(3.83)	(2.57)	(.68)				
											.026	-1.97	-.32	.262	.108	5.64	2.16
											(3.33)	(2.43)	(.53)	(3.07)			

Table 5. Stock returns and inflationary expectations as given by equation (4), January 1969 through December 1982. (t-statistics in parentheses.)

Panel A: Expectations Model

$$\pi_t = \alpha + \beta \sum_{i=1}^{24} M_{t-i} + \gamma \sum_{j=1}^{6} T_{t-j} + \sum_{k=1}^{3} \delta_k \pi_{t-k} + \phi D_t$$

Money Measure	Constant α	Money β	Output γ	Dummy ϕ	π_{t-1} δ_1	π_{t-2} δ_2	π_{t-3} δ_3	r^2	DW
M_1	.0030	.0213	-.0051	-.0046	-	-	-	.182	1.90
	(2.03)	(4.56)	(.78)	(2.76)					
M_2	-.0042	.0493	-.0050	-.0046	-	-	-	.150	1.86
	(1.19)	(3.85)	(.74)	(2.70)					
M_1	.0026	.0200	-.0041	-.0043	.036	.074	-.027	.188	1.97
	(1.69)	(3.84)	(.60)	(2.57)	(.43)	(.90)	(.33)		
M_2	-.0038	.0438	-.0037	-.0043	.058	.081	-.018	.159	1.98
	(1.06)	(3.09)	(.54)	(2.47)	(.68)	(.97)	(.21)		

Panel B: Stock Returns and Inflationary Expectations

$$R_t = a + b_1 E(\pi_t) + b_2 [\pi_t - E(\pi_t)] + b_3 R_{t-1}$$

Money Measure	Constant a	Expected b_1	Unexpected b_2	R_{t-1} b_3	r^2	F	DW
M_1	.042	-3.40	-.50	-	.063	4.77	1.64
	(3.92)	(2.95)	(.92)				
	.035	-2.90	-.47	.229	.115	6.04	2.14
	(3.24)	(2.55)	(.88)	(2.84)			
M_2	.040	-3.20	-.65	-	.052	3.85	1.59
	(3.41)	(2.50)	(1.21)				
	.034	-2.87	-.56	.241	.109	5.73	2.13
	(2.96)	(2.30)	(1.07)	(3.01)			
M_1	.042	-3.47	-.46	-	.067	5.07	1.65
	(4.05)	(3.07)	(.85)				
	.035	-2.88	-.46	.222	.115	6.04	2.13
	(3.25)	(2.55)	(.86)	(2.74)			
M_2	.043	-3.50	-.56	-	.061	4.56	1.61
	(3.76)	(2.83)	(1.05)				
	.035	-2.99	-.52	.231	.113	5.94	2.12
	(3.12)	(2.46)	(.98)	(2.87)			

Table 6. Stock returns and future real activity, January 1970 through December 1982. (Figures in parentheses are t-statistics; asterisks denote that the coefficient of serial correlation is at least two standard deviations greater or less than zero).

Months n	α	β	r^2	DW	ρ_1	ρ_2	ρ_3	ρ_4
Panel A: Nominal Returns $R_t = \alpha + \beta \sum_{i=1}^{n} T_{t+i}$								
3	.0100 (3.15)	.0545 (1.10)	.009	1.57	.21*	.16	.12	.04
6	.0096 (3.04)	.0685 (1.57)	.019	1.59	.20*	.15	.10	.01
9	.0086 (2.79)	.1331 (3.22)	.073	1.68	.16	.14	.10	-.03
12	.0085 (2.68)	.1139 (2.65)	.051	1.67	.16	.10	.05	-.03
18	.0078 (2.41)	.0927 (2.63)	.051	1.64	.18*	.12	.08	-.01
24	.0091 (2.73)	.0358 (1.11)	.009	1.58	.21*	.16	.11	.02
Panel B: Real Returns $(R_t - \pi_t) = \alpha + \beta \sum_{i=1}^{n} T_{t+i}$								
3	.0014 (.43)	.0462 (.88)	.006	1.47	.26*	.19*	.17	.09
6	.0010 (.31)	.0721 (1.57)	.019	1.49	.25*	.17	.14	.06
9	-.0000 (.01)	.1432 (3.30)	.077	1.60	.20*	.15	.13	.01
12	-.0004 (.12)	.1345 (3.00)	.065	1.61	.19*	.10	.07	.00
18	-.0014 (.40)	.1148 (3.13)	.070	1.58	.21*	.12	.10	.01
24	-.0002 (.06)	.0589 (1.74)	.023	1.51	.24*	.16	.14	.06

Table 7. Inflation and future real activity, January 1970 through December 1982. (Figures in parentheses are t-statistics; asterisks denote that the coefficient of serial correlation is at least two standard deviations greater or less than zero).

Months n	α	β	r^2	DW	ρ_1	ρ_2	ρ_3	ρ_4
Panel A: Actual Inflation and Future Real Activity $\pi_t = \alpha + \beta \sum_{i=1}^{n} T_{t+i}$								
3	.0079 (14.84)	.0057 (.66)	.003	1.40	.30*	.31*	.25*	.19*
6	.0081 (14.96)	-.0075 (.99)	.007	1.44	.28*	.29*	.21*	.15
9	.0082 (15.25)	-.0151 (2.08)	.030	1.52	.24*	.25*	.15	.11
12	.0085 (16.04)	-.0262 (3.68)	.087	1.64	.18*	.18*	.10	.06
18	.0086 (16.25)	-.0231 (4.05)	.104	1.63	.18*	.20*	.10	.00
24	.0088 (16.43)	-.0225 (4.35)	.118	1.69	.15	.14	.08	.04
Panel B: Expected Inflation and Future Real Activity: $E(\pi_t) = \underset{(2.03)}{.0030} + \underset{(4.56)}{.0213} \sum_{i=1}^{24} M_{1t-1} - \underset{(.78)}{.0051} \sum_{j=1}^{6} T_{t-j} - .0046D_t$; $E(\pi_t) = \alpha + \beta \sum_{i=1}^{n} T_{t+i}$								
3	.0091 (37.13)	.0006 (.14)	.000	.74	.60*	.57*	.51*	.45*
6	.0091 (37.07)	-.0018 (.51)	.002	.74	.61*	.56*	.50*	.43*
9	.0092 (37.72)	-.0067 (2.04)	.034	.79	.58*	.53*	.46*	.40*
12	.0093 (39.06)	-.0115 (3.54)	.096	.84	.56*	.48*	.41*	.33*
18	.0093 (39.21)	-.0095 (3.81)	.109	.84	.56*	.44*	.39*	.32*
24	.0094 (39.45)	-.0091 (4.02)	.120	.87	.54*	.46*	.39*	.30*

Table 8. Real stock returns, inflationary expectations and future real activity, January 1969 through December 1982, monthly data. (t-statistics are in parentheses, asterisks denote that the coefficient of serial correlation is at least two standard deviations greater or less than zero.)

$$(R_t - \pi_t) = \alpha + \beta_1 E(\pi_t) + \beta_2[\pi_t - E(\pi_t)] + \beta_3 \sum_{i=1}^{n} T_{t+i}$$

months n	α	β_1	β_2	β_3	r^2	F	DW	ρ_1	ρ_2	ρ_3	ρ_4
Panel A: Contemporaneous Inflation as an Expectations Proxy:											
–	.0213 (4.02)	-2.30 (4.59)	–	–	.139	21.06	1.69	.15	.15	.05	-.03
6	.0205 (3.88)	-2.27 (4.55)	–	.064 (1.49)	.154	11.74	1.73	.13	.13	.04	-.05
12	.0177 (3.22)	-2.04 (4.01)	–	.092 (2.11)	.168	13.05	1.75	.12	.11	.03	-.06
18	.0168 (2.92)	-1.98 (3.80)	–	.071 (1.93)	.164	12.62	1.71	.14	.12	.05	-.04
24	.0208 (3.47)	-2.26 (4.19)	–	.006 (.20)	.140	10.47	1.68	.15	.14	.06	-.03
Panel B: ARIMA (1,0,1) Estimates of Expected Inflation											
–	.0437 (5.73)	-5.16 (5.90)	-1.49 (2.88)	–	.230	19.28	1.80	.10	.06	-.02	-.11
6	.0424 (5.38)	-5.03 (5.60)	-1.51 (2.91)	.027 (.63)	.233	12.93	1.81	.09	.05	-.02	-.11
12	.0403 (4.69)	-4.81 (4.99)	-1.45 (2.79)	.039 (.87)	.235	13.09	1.82	.09	.05	-.02	-.11
18	.0411 (4.52)	-4.91 (4.89)	-1.45 (2.76)	.020 (.52)	.232	12.87	1.80	.10	.05	-.02	-.11
24	.0489 (5.46)	-5.66 (5.77)	-1.63 (3.06)	-.038 (1.11)	.238	13.29	1.81	.09	.05	-.03	-.12
Panel C: Money-Based Estimates of Expected Inflation. (See equation (4)).											
–	.0376 (3.27)	-4.11 (3.41)	-1.80 (2.91)	–	.147	10.06	1.71	.14	.14	.05	-.00
6	.0359 (3.10)	-3.99 (3.30)	-1.77 (2.86)	.054 (1.14)	.156	7.15	1.74	.13	.12	.04	-.01
12	.0294 (2.53)	-3.40 (2.83)	-1.61 (2.66)	.126 (2.74)	.199	9.58	1.79	.10	.12	.07	-.04
18	.0299 (2.38)	-3.42 (2.66)	-1.62 (2.59)	.058 (1.48)	.163	7.50	1.72	.14	.12	.05	-.01
24	.0392 (3.07)	-4.25 (3.26)	-1.84 (2.89)	-.011 (.29)	.147	6.68	1.71	.14	.14	.05	-.01

Table 9. Real stock returns, inflationary expectations and real activity for January 1970 through December 1982, quarterly data. (t-statistics are in parentheses.)

$$(R_t - \pi_t) = \alpha + \beta_1 E(\pi_t) + \beta_2 [\pi_t - E(\pi_t)] + \beta_3 \sum_{i=1}^{n} T_{t+i}$$

Real Activity Measure	Industrial Output							GNP						
Quarters n	α	β_1	β_2	β_3	r^2	F	DW	α	β_1	β_2	β_3	r^2	F	DW
Panel A: Contemporaneous Inflation as Expectations Proxy:														
–	.081	-2.96	–	–	.263	14.96	1.75	–	–	–	–	–	–	–
	(3.64)	(3.87)												
2	.078	-2.88	–	.142	.283	8.08	1.80	.080	-2.97	–	.065	.264	7.35	1.77
	(3.47)	(3.74)		(1.07)				(3.49)	(3.83)		(.26)			
4	.070	-2.64	–	.162	.286	8.21	1.79	.046	-2.40	–	.564	.312	9.29	1.95
	(2.93)	(3.25)		(1.16)				(1.56)	(2.93)		(1.71)			
6	.070	-2.66	–	.119	.278	7.88	1.71	.063	-2.74	–	.231	.282	8.05	1.89
	(2.76)	(3.19)		(.93)				(2.23)	(3.44)		(1.05)			
8	.091	-3.25	–	-.085	.272	7.64	1.83	.072	-2.81	–	.075	.264	7.34	1.76
	(3.41)	(3.73)		(.71)				(1.67)	(2.87)		(.26)			
Panel B: ARIMA Estimates of Expected Inflation:														
–	.145	-5.68	-1.53	–	.454	17.07	2.00	–	–	–	–	–	–	–
	(5.64)	(5.81)	(2.00)											
2	.142	-5.58	-1.54	.055	.457	11.23	2.02	.150	-5.80	-1.46	-.151	.460	11.38	1.98
	(5.33)	(5.51)	(1.99)	(.46)				(5.55)	(5.79)	(1.88)	(.67)			
4	.139	-5.47	-1.45	.066	.458	11.27	2.04	.126	-5.26	-1.39	.243	.463	11.48	2.10
	(4.86)	(5.12)	(1.83)	(.53)				(3.53)	(4.68)	(1.75)	(.78)			
6	.146	-5.72	-1.55	-.007	.454	11.11	2.00	.152	-5.83	-1.55	-.062	.456	11.16	1.97
	(4.75)	(5.10)	(1.94)	(.06)				(4.32)	(5.23)	(1.99)	(.29)			
8	.164	-6.26	-1.94	-.137	.477	12.15	2.09	.183	-6.45	-1.94	-.260	.467	11.68	1.93
	(5.58)	(5.87)	(2.36)	(1.30)				(3.92)	(5.13)	(2.22)	(.97)			
Panel C: Money-Based Estimates of Expected Inflation:														
–	.111	-4.04	-2.64	–	.236	5.11	1.65	–	–	–	–	–	–	–
	(2.10)	(2.22)	(2.30)											
2	.101	-3.71	-2.46	.204	.259	3.73	1.71	.111	-4.07	-2.63	.053	.237	3.32	1.67
	(1.87)	(2.01)	(2.21)	(.99)				(2.07)	(2.19)	(2.26)	(.18)			
4	.070	-2.70	-2.06	.326	.287	4.29	1.69	.074	-2.88	-1.88	.743	.303	4.64	1.86
	(1.19)	(1.34)	(1.73)	(1.50)				(.89)	(1.53)	(1.57)	(1.75)			
6	.090	-3.38	-2.38	.126	.249	3.53	1.61	.091	-3.73	-2.42	.234	.255	3.65	1.79
	(1.49)	(1.65)	(1.97)	(.73)				(1.59)	(2.01)	(2.06)	(.90)			
8	.143	-5.06	-3.07	-.173	.262	3.78	1.81	.119	-4.20	-2.70	-.046	.237	3.31	1.64
	(2.35)	(2.45)	(2.52)	(1.04)				(1.37)	(1.77)	(2.08)	(.11)			

Table 10. Stock returns and exchange rate disequilibrium; monthly data January 1970 to December 1982. (t-statistics are in parentheses.)

Panel A: Disequilibrium measured by visible trade imbalance.

$$\bar{R}_t = \alpha + \beta \sum_{i=1}^{n} \frac{1}{n} \frac{X_{t+i} - I_{t+i}}{I_{t+i}}$$

Panel B: Disequilibrium measured by change in foreign exchange reserve.

$$\bar{R}_t = \alpha + \beta \sum_{i=1}^{n} F_{t+1}$$

n	α (A)	β (A)	r^2 (A)	DW (A)	α (B)	β (B)	r^2 (B)	DW (B)
6	.0103	.0021	.000	1.55	.0102	-.0011	.000	1.55
	(2.48)	(.07)			(3.18)	(.11)		
12	.0100	-.0018	.000	1.55	.0107	-.0063	.006	1.56
	(2.33)	(.06)			(3.32)	(.87)		
18	.0079	-.0270	.005	1.55	.0111	-.0076	.011	1.57
	(1.82)	(.79			(3.42)	(1.24)		
24	.0057	-.0544	.010	1.58	.0119	-.0107	.028	1.59
	(1.30)	(1.51)			(3.64)	(1.94)		

Notes

[1]For a detailed discussion on these propositions, see Geske and Roll (1983, pp. 3-6).

[2]As will be pointed out at a later stage, short-term interest rates, for reasons associated with the regulation of local financial markets, cannot be used to measure inflationary expectations in Finland.

[3]For IFS-indices, probably based on less than market-wide and somewhat incorrectly weighted Finnish market indices, Gultekin (1983a) reports significant first but insignificant second order autocorrelation. For a more detailed treatment of the time-series properties of Finnish security prices see Berglund-Wahlroos-Ornmark (1983).

[4]High quality paper of short maturity is only traded between banks in Finland. Records of rates at which these trades take place have only been kept from the late 1970s.

[5]This, of course, requires inflationary expectations at the end of t - 1 and stock returns in t to be based on all available information and that prediction errors constitute white noise.

[6]Note, however, that an absence of positive correlation between stock returns and inflation predicted by the Fisher hypothesis (although not the significant negative relation) may be explained by the error-in-variable problem discussed in Gultekin (1983a, pp. 55-56).

[7]For a discussion of the properties of that rationale see, e.g., Evans and Honkapohja (1984).

[8]Note that by estimating the parameters of the ARIMA models from the full data set and not just observations prior to our stock return observation, we are in effect assuming that the "structure" of the inflationary process is stable and that market participants are knowledgeable of this structure. Tests with ARIMA models based on 36 month estimation periods indicated fairly low variance in parameter estimates over the time period studied. In ARIMA (1,0,1) models AR1-coefficients varied between .98 and 1.00 and MA1-coefficients between .81 and .97.

[9]In close analogy to the ARIMA models, this presupposes that the true coefficient values of equation (3) are known to investors.

[10]This procedure is discussed in Fama (1981, pp. 548-549) and Fama (1982).

[11]Note that we are using monthly inflation rates and biannual money growth data. Slope coefficients must hence be multiplied by 24 to yield the relevant measure.

[12]After the breakdown of the Bretton Woods system, the Finnish mark experienced a short "floating" period. In 1973 the central bank pegged its value to an undisclosed basket. Since 1977 pegging has been based on the Foreign Exchange Act. Exchange rate variation around the central peg has varied. The period 1976-1979 was one of high variability wheras the early 1980s experienced a stricter peg.

[13]There seems to be good reason for such an interpretation. Inflation rates are fairly good short-term (6-18 month) predictors of trade deficits.

[14]Current account data was available to us only at the quarterly level.

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