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N. BULENT GULTEKIN*

ABSTRACT

This study uses data from the Livingston survey of expectations to examine the Fisher hypothesis as a model relating *expected* stock returns and *expected* inflation. We show that the Fisher hypothesis holds much better for ex ante expectations than ex post realizations.

RECENT STUDIES SUCH AS those by Nelson [15], Jaffe and Mandelker [10], Bodie [1], Fama and Schwert [3], and others have shown that the relation between stock returns and inflation is negative in the U.S. and have concluded that the Fisher hypothesis does not hold in the stock market. Gultekin [9] has expanded the above studies for a large sample of countries besides the U.S. His time series results for the whole sample also are not consistent with the Fisher Hypothesis. All of these studies use ex post realizations of stock returns and, with some exceptions, ex post inflation rates in order to test the Fisher effect.[1]

In contrast to earlier research, this study uses data from the Livingston survey of expectations to test the Fisher Effect in its pure form as a model relating *expected* stock returns to *expected* inflation. Our findings are remarkably different from those of previous studies which use ex post data. Expectations data from the Livingston surveys show a positive one-to-one relation between expected stock returns and expected inflation. We also find that the expected real return on stocks is not constant over time but is positively related to expected inflation, which is contrary to the relation suggested by Mundell [14]. The next section provides some theoretical considerations and a brief summary of results from earlier research. The third section describes the Livingston data and presents the empirical results. Some estimates of the expected real rate return on stocks

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[1] Fama and Schwert estimate expected inflation rates from T-Bills. They use, however, ex post stock returns as estimates of expected stock returns.

and a simple test of the Mundell Effect are given in Section III. Section IV summarizes the findings.

I. Some Theoretical Considerations and Previous Research

Fisher [6] in his seminal work on interest rates suggested that the nominal interest rate fully reflects the available information about the future values of the inflation rate and, thus, the nominal interest rate can be expressed as the sum of a "real" rate and an expected inflation rate. This proposition, also known as the Fisher Effect or Fisher Equation, has been widely accepted among financial economists and can be generalized to rates of return on common stocks and other assets. Fama and Schwert [3] explain the generalized Fisher effect such that the market, if it is efficient and reflects all the available information at time $t - 1$, will set the price of common stocks so that the expected nominal return from $t - 1$ to t is the sum of the appropriate equilibrium expected real rate and the market's assessment of the expected inflation rate for the same time period. Formally

$$E(\tilde{R}_t \mid \phi_{t-1}) = E(\tilde{r}_t \mid \phi_{t-1}) + E(\tilde{\pi}_t \mid \phi_{t-1}) \tag{1.1}$$

where $(\tilde{R}_t)$ is the nominal return on an asset, $E(\tilde{r}_t \mid \phi_{t-1})$ is the equilibrium expected real return, and $E(\tilde{\pi}_t \mid \phi_{t-1})$ is the expected inflation rate; i.e., the market uses the information set ϕ at $t - 1$ to assess the expected rate of inflation and to determine the expected real return on common stocks with an appropriate risk premium. Then the market sets the price of common stocks such that the expected nominal return is the sum of the equilibrium expected real return and the best possible assessment of the expected inflation.

Empirical studies investigating the Fisher effect have further asserted that the expected real rate is constant or independent of the expected inflation rate. This assertion obviates the need, otherwise, for a complete general equilibrium model for the expected real returns.

The tests of the joint hypothesis that the market is efficient and that the expected real return and the expected inflation rate are independent can be obtained from the following standard regression model:

$$\tilde{R}_t = \alpha + \beta E(\tilde{\pi}_t \mid \phi_{t-1}) + \tilde{e}_t \tag{1.2}$$

The regression model in (1.2) estimates the conditional expected value of the dependent variable as a function of the independent variable. Provided that the expected inflation rate can be estimated, an estimate of β that is indistinguishable from unity is consistent with the hypothesis that the expected return on common stocks moves in one-to-one correspondence with the expected inflation rate. Also, since the expected real return is equal to the expected nominal return minus the expected rate of inflation, an estimate of β which is statistically indistinguishable from unity is also consistent with the hypothesis that the expected real return on common stocks and the expected inflation rate are uncorrelated.

While studies in Gibson [7, 8], Fama and Schwert [3] and others have found a positive relation between nominal interest rates and inflation in the government bond markets, studies in the U.S. stock market have revealed an anomalous negative relation between nominal stock returns and inflation.

Table I presents two sets of estimates of the model (1.2) using stock market returns and contemporaneous inflation rates for the period 6/1952–12/1979. The model is estimated by ordinary least squares with an adjustment for first-order autocorrelation. Panel A presents regression results using semi-annual data while Panel B uses annual data.[2] Stock market returns are returns on Standard and Poor's 500 (S&P 500) index. Inflation is computed from both the consumer and the wholesale price indices.

The results in Table I do not change materially if various estimates of the expected inflation rate are substituted for the contemporaneous inflation rate in model (1.2). For example, Nelson [15] and Gultekin [9] estimate expected inflation from past inflation rates using time series models. Fama and Schwert [3] estimate expected inflation from monthly Treasury Bill returns. These results are similar to those in Table I.

The negative estimate of β in (1.2) is surprising since corporate equity represents a claim on real assets. Two possible explanations are evident. First, the results may be due to problems in estimating expected stock returns and the expected inflation rate from the realized data. Second, the proposition that the expected real return and the expected inflation rate are uncorrelated may not be true.[3] The Livingston data allow us to test the Fisher Equation directly in its pure form as a model relating expected common stock returns to expected inflation. Furthermore, it is possible to estimate (1.2) cross-sectionally with individual forecasts to avoid bias due to the omission of the expected real rate.

II. Data and Empirical Results

A. *Source and the Statistical Properties of the Data*

Every June and December since 1946, Joseph A. Livingston, a Philadelphia newspaper columnist, has solicited forecasts of economic activity from more than fifty business economists. The expected inflation data from the consumer and the wholesale price index (CPI and WPI) forecasts have been extensively used in the finance and economics literature.[4] The Dow Jones Industrial Price Index

[2] The particular time period is chosen to match the Livingston survey data.

[3] Fama [4] has shown recently that when the growth rate of the industrial production index or gross national product is included in the regression model (1.2), the regression coefficient for expected inflation is no longer statistically negative in the U.S. He concludes that the negative relation between stock returns and expected inflation is spurious. Gultekin [9] has provided evidence that there is a positive relation between stock returns and inflation across a number of countries while the stock market reacts negatively to the contemporaneous inflation rates in most countries. These studies suggest that Equation (1.2) may not be appropriate for testing the Fisher equation on account of an omitted variable.

[4] The earliest works are Turnovsky [17] and Gibson [8]. The most recent work on price expectations data along with a good summary of the past work is in Figlewski and Wachtel [5]. Also an extensive anlaysis of the properties of the price expectations data can be found in Wachtel [18] and Carlson [2].

Table I

Regressions of Nominal Stock Returns on Concurrent Inflation Rates

$$\tilde{R}_t = \alpha + \beta \tilde{\pi}_t + \tilde{e}_t$$

Price index	α	β	$t(\alpha)$	$t(\beta)$	R^2	F	DW	ρ	Time period
Panel A: Semi-annual regressions									
CPI	.0729	−2.4114	3.48	−2.90	.1374	8.44	1.99	−.119	6/1952–12/1979
WPI	.0581	−1.3014	2.86	−2.27	.0889	5.17	2.00	−.101	
CPI	.1039	−8.2093	3.71	−2.51	.2023	6.34	2.03	−.113	6/1952–12/1965
WPI	.0525	−1.0131	2.21	−.42	.0072	.18	1.97	.027	
CPI	.0964	−2.7992	1.99	−2.00	.1384	4.02	1.96	−.187	6/1966–12/1979
WPI	.0525	−1.3274	1.59	−1.71	.1051	2.93	2.00	−1.79	
Panel B: Annual regressions									
CPI	.1319	−2.0885	3.50	−2.74	.2316	7.53	2.10	−.266	6/1952–12/1979
WPI	.1064	−1.4531	3.37	−2.71	.2276	7.37	2.13	−.236	

$\tilde{R}_t$ is the six and twelve-month rate of return on the S&P 500 Index;

$\tilde{\pi}_t$ is the concurrent six and twelve-month change in the consumer (CPI) or wholesale (WPI) price indexes.

Regressions are adjusted for first order autocorrelation by the Cochrane-Orcutt method.

DW refers to the transformed series.

ρ is the first order autocorrelation.

was included between June 1946 and December 1951 and was replaced thereafter by the S&P 500 Index in June 1952.

In each semiannual survey, Livingston requested forecasts for six and twelve months ahead. For example, the June 1946 survey asked for month-end predictions for December 1946 and June 1947. In the June surveys between 1947 and 1971, he also asked for predictions eighteen months ahead.

Carlson [2] and Figlewski and Wachtel [19] have pointed out two major problems in constructing expected inflation series from the Livingston series. First, Livingston made some adjustments in the predictions of the participants. Second, since the survey asks for predictions of the *level* of the CPI, WPI, and stock market indices, it is necessary to know the actual indices which are used as the base by the forecasters at the time of the predictions in order to calculate the forecasts of the inflation rate and stock market returns.

There is a good deal of ambiguity in the literature about the calculation of the expected inflation rates from this survey. Livingston generally mails the questionnaires to the participants in early December and May along with the most recently reported level of price indices as well as other available economic data. For most surveys Livingston supplied the October and April figures. It is not clear, in general, whether forecasters used those figures supplied by Livingston or the most recent publicly available information to make their predictions.

The problems of selecting the correct base period for the stock market index is even more difficult, since observed stock market indices exhibit considerable variability. Furthermore, CPI and WPI figures are available monthly whereas stock market indices are available daily. Thus, it is impossible to know the exact value of the stock market index which each forecaster used; therefore, measurement errors could be potentially very serious.

The method used in this study in calculating the expected inflation rates and the expected stock market return series avoids all possible statistical problems caused by the arbitrary changes made by Livingston and the ambiguity of the base period. First, the expectations data in this study are computed from each *individual respondent's raw forecast*, instead of from the summaries published in Livingston's columns. The base period problem is solved as follows. Every December and June, each forecaster makes a six-month and a twelve-month prediction, and an additional eighteen-month prediction each June. Thus, in any given December designated as month t, we have the forecasts for the months $t + 6$ and $t + 12$. Now at time t it is possible to compute a six-month inflation rate and stock market returns which are expected to prevail for the period starting at $t + 6$ and ending at $t + 12$ in an analogous manner to forward rates in the term structure literature.

More formally, using the term structure of interest rates notation, the forecast return on an index is defined as

$$_{t+6}R_{6,t} = \frac{_tI_{t+12}}{_tI_{t+6}} - 1 \tag{2.1}$$

where $_tI_{t+k}$ indicates the forecast of an index (CPI, WPI, or S&P 500) made at time t for the month $t + k$. $_{t+6}R_{6,t}$ is the expected six-month rate of return on index I starting at month $t + 6$ and forecasted at time t. Likewise, the twelve-month rate of return on an index can be computed for the period beginning at $t + 6$ and ending at $t + 18$ for each June.

The inflation rate and the market return forecasts are computed for each individual forecaster as in (2.1). The arithmetic averages of these individual forecasts are used as consensus forecasts.

Expected inflation rates derived from both the consumer and the wholesale price indexes have high positive autocorrelation. These autocorrelations are much higher than the autocorrelations in observed inflation rates. This is consistent with the findings of Figlewski and Wachtel [5] that price expectations are formed by some adaptive scheme. The expected inflation series also exhibits wide fluctuations over the subperiods. Of particular interest is the period following World War II. Expected inflation rates are systematically negative for each period until 6/1950. This is the period when early Keynesians (or stagnationists) predicted another depression once the military expenditures ceased after World War II. In other subperiods, the expected inflation rates are positive but generally lower than the actual inflation rates.

The expected stock market return series also exhibits high positive serial correlation, although the actual series do not. Expected stock market returns vary widely among subperiods. When forecasters predicted a depression after World War II, the expected market return was at an annualized rate of −.8 percent between 6/1947–12/1957. For the same period, the actual stock market return was 10.6%. During the 1969–79 period, the average expected stock market return was 8.9%, whereas the actual returns were 2.7%.

We also computed six and twelve-month rates of change in the forecasts of the CPI, WPI, and S&P 500 indexes, using November and May as the base periods. This method was suggested by Carlson [2] and widely used in the literature.

Table II

Regressions of Expected Nominal Stock Market Returns on Expected Inflation Rates

$E(\tilde{R}_t) = \alpha + \beta E(\tilde{\pi}_t) + \tilde{e}_t$

Price index	α	β	$t(\alpha)$	$t(\beta)$	R^2	F	DW	ρ	Time period
PANEL A									
I. SEMI-ANNUAL FORECASTS									
CPI	−.0039	1.7896	−.55	4.92	.3137	24.22	1.71	.394	6/1962–12/1979
WPI	.0016	1.5724	.25	4.71	.2951	22.19	1.72	.399	
CPI	−.0058	2.2009	−.73	1.69	.1034	2.88	1.68	.281	6/1952–12/1965
WPI	−.0015	1.8917	−.26	2.29	.1744	5.28	1.73	.235	
CPI	.0038	1.5407	.18	2.01	.1392	4.04	1.66	.480	6/1966–12/1979
WPI	.0210	.9312	1.23	1.49	.0821	2.23	1.61	.475	
II. ANNUAL FORECASTS									
CPI	−.0069	2.5657	−1.02	6.76	.6394	28.37	1.81	−.361	6/1952–6/1971
WPI	.0087	2.1573	1.08	4.21	.4569	13.45	1.79	−.158	
PANEL B									
I. SEMI-ANNUAL FORECASTS									
CPI	.0729	1.7224	6.17	3.68	.2031	13.51	1.91	.3706	6/1952–12/1979
WPI	.0854	1.7520	11.72	5.39	.3539	29.04	1.84	.2349	
II. ANNUAL FORECASTS									
CPI	.0686	1.7609	4.98	5.75	.3842	33.06	1.87	.4083	6/1952–12/1979
WPI	.0790	1.9733	9.75	8.96	.6021	80.21	1.79	.1520	
III. EIGHTEEN MONTH FORECASTS									
CPI	.0638	2.2207	5.87	6.51	.7135	42.33	1.93	−.0974	6/1952–12/1971
WPI	.0734	2.3617	5.42	4.86	.5814	23.61	2.30	.1449	

Panel A uses expectations data computed as in Equation (2.1). Data in Panel B are computed by the Carlson method. Regressions are adjusted for first-order serial correlation by the Cochrane-Orcutt method. ρ is the first order autocorrelation.

While this method does not solve the base period selection problem completely, it provides forecasts for the more immediate future than the previous method. The statistical properties of these data series are similar to those described above.[5]

In order to create a consistent data series, we use only forecasts for the period June 1952 to December 1979 when the S&P 500 index forecasts are available.[6]

B. *Empirical results*

The regression model (1.2) is estimated by using consensus expectations data for the 6/1952–12/1979 period and for subperiods. The results are presented in Table II. Data for Panel A regressions are "forward" expected variables that are computed by (2.1). Panel B regressions are estimated by using the data computed by the Carlson method.[7] All the regressions in Table II are adjusted for first-order autocorrelation by the Cochrane-Orcutt method.

[5] For further analysis of the properties and the accuracy of CPI, WPI, and stock market indexes, see Figlewski and Wachtel [5] and Lakonishok [11], respectively.

[6] All the analyses in this study are repeated by using the whole sample period. Results are identical to the ones reported here.

[7] Both methods of computing expected variables yield similar results. From here on only the results with "forward" expected variables will be reported.

Table III

Pooled Cross-Section Time Series Regressions of Expected Nominal Stock Market Return on Expected Inflation Rates 6/1952–12/1979

Price index	α	β	$t(\alpha)$	$t(\beta)$	R^2	F	DW
Panel A: Constant intercept							
CPI	−.0042	1.5878	−2.21	16.69	.1131	278.42	1.89
WPI	.0026	1.3156	1.56	16.87	.1179	284.43	1.86
Panel B: Time varying intercept							
CPI		1.2775		8.47	.2194	10.69	2.13
WPI		.9388		9.04	.2291	11.22	2.11

In Panel A, individual forecasts for each time period are stacked and a single cross-sectional time series pooled regression is estimated. The number of observations is 2185 when observations are pooled. In Panel B, a dummy variable is added for each time period to allow the intercept term to vary while constraining the regression coefficient β to be the same for all periods. Since there are 56 intercept estimates, they are not reported in Panel B.

These results are remarkably different from those reported in Table I: the stock market returns and expected inflation rates are strongly positively related. This positive relation is in line with the Fisher Effect in general. The estimates of β which are reliably greater than unity are not, however, consistent with the simple form of the Fisher Hypothesis stated in Section I. This may be because the real rate in (2.1) is not constant and correlated with expected inflation or it may be due to the simple averaging of individual forecasts.[8]

We re-estimated regression equation (1.2) as a pooled cross-section-time series model with the individual data. This cross-section time series model does not assign equal weights to each forecaster as in consensus data. The results are presented in Panel A in Table III for the whole sample period. While the efficiency of the regression coefficients has been improved considerably using the individual data, the estimates of the regression coefficient are still reliably greater than unity.

In order to allow a time varying real rate, we fit a single cross-section time series regression on all of the individual responses with a dummy variable for each time period, while constraining the inflation forecast coefficient to be constant over time. The results are shown in Panel B in Table III. The estimates of the regression coefficient now are not distinguishable from unity. This is very strong evidence for the Fisher Equation, which predicts that expected nominal stock returns vary in one-to-one correspondence with the expected inflation when we account for the movvements in the real returns.[9]

[8] If the real rate is not independent of expected inflation regression coefficients estimated in (1.2) will be biased. This bias will be equal to the true coefficients on the (omitted) expected real rate variable multiplied by the regression coefficient obtained from an "auxiliary" regression of the excluded variables on the included variables. Progressive taxes may create further dependencies between the real rate and the expected inflation rate. The results in Table II, however, imply much larger marginal tax rates than the existing tax rates.

[9] We also re-estimated the model (1.2) using cross-sectional individual data every six months between 6/1952–12/1979. The means of the time series of the regression coefficient are 1.3409 and 1.1638 for CPI and WPI data respectively. These values are not distinguishable from unity.

The above results are in contrast with the results of those studies in which realized stock market returns and inflation rates are used as proxies for the expected counterparts. One possible explanation for this discrepancy could be the reaction of stock returns to the unanticipated component of inflation. The regression model in (1.2) is re-estimated by substituting realized stock market returns on the S&P 500 index in place of expected returns from the Livingston data. The results are presented in Panel A in Table IV for the period 6/1952–12/1979. There is no reliable relation between realized stock market returns and the expected inflation. Results, however, are different once the unanticipated inflation is included as an additional explanatory variable in the regressions. Unanticipated inflation here is defined as the difference between the realized and the expected inflation from Livingston data. The relation between realized stock market returns and unanticipated inflation is reliably negative. This conclusion is only valid to the extent that the data from Livingston surveys are representative of the market expectations. This result is not, however, consistent with the arguments of Modigliani and Cohn [12] who claimed that in inflationary periods investors capitalize real earnings at nominal rates rather than at real rates. Forecasters in our sample do not seem to confuse the nominal rates with real rates.

III. Some Estimates of Expected Real Returns

Most of the previous research in this area as indicated earlier asserted that the expected real rate is constant or that it is uncorrelated with expected inflation. Mundell [14] argued that there is a negative relation between expected real rates and expected inflation. Santomero [16] claimed that studies which test the Fisher Effect on interest rates with expectation data can be biased because of the correlation between expected real rates and inflation.[10] He did not, however, offer any particular sign of this correlation.

The difference between the time series and pooled cross-sectional time series results in the previous section is not consistent with the proposition that expected real rate is constant or unrelated with expected inflation. Recent research by Fama [4] and Mishkin [13] also cast doubt about this commonly held view.

In this section, we formally test the time invariance of the expected real return on common stocks and the correlation with the expected inflation. If the expected real return on common stocks is time invariant, the estimates of the coefficients for the dummy variables in the pooled cross-section time series regression in Table III should be indistinguishable from zero and the F-statistic measuring the joint significance of the dummy variable should be statistically insignificant. These coefficients represent the estimates of the real return from Equation (1.1). The F-values for this test are 5.180 and 5.684 for the CPI and WPI inflation data with (55, 2129) degrees of freedom. We can reject the hypothesis stating a constant real return on common stocks at any conventional significance level.

The correlation between expected real return on common stocks and expected inflation is estimated by regressing the estimates of the expected real stock return

[10] See footnote 7.

Table IV

Regressions of Nominal Stock Returns on Expected and Unexpected Inflation Rates

Price index	α	β_1	β_2	$t(\alpha)$	$t(\beta_1)$	$t(\beta_2)$	$\bar{R}^2$	F	DW	Time period
Panel: A				$\tilde{R}_t = \alpha + \beta E(\tilde{\pi}_t) + \tilde{e}_t$						
CPI	.0447	−.8017		2.98	−1.04		.0013	1.08	2.08	6/1952–12/1979
WPI	.0414	−.565		2.93	−.88		.0000	.77	2.08	
Panel: B				$\tilde{R}_t = \alpha + \beta_1 E(\tilde{\pi}_t) + \beta_2[\tilde{\pi}_t - E(\tilde{\pi}_t)] + \tilde{e}_t$						
CPI	.0702	−.5285	−4.0997	3.20	−.42	−3.08	.1435	5.44	2.27	6/1952–12/1979
WPI	.0804	−1.0489	−3.8594	3.74	−.97	−3.03	.1375	5.22	2.27	

$\tilde{R}_t$ is the realized six-month rate of return on the S&P 500 index.
π_t is the realized six-month inflation rate.
$E(\pi_t)$ is the six-month expected inflation rate from Livingston survey data.
$\pi_t - E(\pi_t)$ is the unexpected inflation rate.

Table V

Relation between Expected Real Rate and Expected Inflation 6/1952–12/1979

$\tilde{r}_t = \gamma_0 + \gamma_1 E(\tilde{\pi}_t)$

Price index	γ_0	γ_1	$t(\gamma_0)$	$t(\gamma_1)$	R^2	F	DW
Panel A							
CPI	−.0071	.4999	−1.53	2.02	.0701	4.07	1.21
WPI	−.0058	.4601	−1.40	2.09	.0748	4.37	1.21
Panel B							
CPI	−.0047	.8890	−1.05	3.63	.1993	13.19	1.24
WPI	−.0015	.7568	−.39	3.43	.1820	11.79	1.21
Panel C							
CPI	−.0042	.7761	−.92	3.21	.1609	10.31	1.21
WPI	−.0018	.6942	−.46	3.23	.1616	10.41	1.21
Panel D							
CPI	−.0011	.6789	−.23	2.80	.1271	7.86	1.21
WPI	.0015	.5649	.38	2.58	.1109	6.74	1.19

$\tilde{r}_t$ is the estimate of the expected real return on common stocks.

In Panels A and B, $\tilde{r}_t$ is the intercept in pooled CPI and WPI regressions in Panel B of Table III respectively.

In Panels C and D, $\tilde{r}_t$ is the difference between expected nominal stock returns and inflation rate from CPI and WPI data respectively.

$E(\pi_t)$ is the concensus forecast for consumer price inflation (CPI) or wholesale price inflation (WPI).

on the expected inflation. We use two sets of estimates for the expected real return. The first set of estimates is the time varying intercepts from the cross-section time series pooled regressions. The second set is simply the difference between the expected nominal stock returns and the expected inflation from the consensus forecasts. These results are presented in Table V. Both estimates of expected real return on stocks have reliably positive correlation with expected inflation. Although this finding is in contrast to the Mundell Effect which predicts a negative correlation, it does not constitute conclusive evidence: the Mundell Effect posits a negative relation between the expected "real" rate of interest and the expected inflation. The expected real return on common stocks includes both a riskless "real" rate of interest and a risk premium appropriate to equity investment. Thus, our results indicate that the risk premium may vary over time positively with expected inflation, rather than substantiating the relation between the riskless "real" rate of interest and the expected inflation.

IV. Conclusions

This study uses data from the Livingston survey of expectations to examine the Fisher effect in its pure form as a model relating expected stock returns to expected inflation. We find that the Fisher Equation holds much better for ex ante expectations than for ex post realizations. There are several implications of the findings in this study. First, unanticipated inflation seems to have a significantly negative effect on ex post stock returns. Second, if the economists sampled in the Livingston survey are representative of the market, then findings here do not support the view of Modigliani and Cohn [12] who argued that "in inflationary periods investors capitalize equity earnings at a rate that parallels the nominal interest rate, rather than the economically correct real rate." Finally, we examined the behavior of expected real returns on common stocks over time. We find that they are not constant over time and, contrary to the Mundell Effect, they are positively correlated with expected inflation.

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