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Stock Market Returns and Inflation: Evidence from Other Countries

N. BULENT GULTEKIN*

ABSTRACT

This paper investigates the relation between common stock returns and inflation in twenty-six countries for the postwar period. Our results do not support the Fisher Hypothesis, which states that real rates of return on common stocks and expected inflation rates are independent and that nominal stock returns vary in one-to-one correspondence with expected inflation. There is a consistent lack of positive relation between stock returns and inflation in most of the countries.

THE SUDDEN SURGE OF price increases since 1973 has revived interest in the properties of financial assets as hedges against inflation. Lintner [20], Oudet [25], Bodie [1], Jaffe and Mandelker [17], and Nelson [24] have all reported that common stocks in the U.S. have been poor hedges against inflation. Fama and Schwert [9] compared the inflation hedge properties of common stock with those of a number of financial and real assets including human capital with results similar to those mentioned above. They found that common stocks are poor hedges not only against unexpected inflation but also against expected inflation. The latter finding is inconsistent with the Fisher Hypothesis which predicts a positive relation between expected nominal returns and expected inflation.[1]

While expected stock returns and expected inflation in the U.S. have been found to be negatively related, Firth [10], in a recent paper, showed that in the United Kingdom the results are just the opposite of those in the U.S. The relation between nominal stock returns and inflation has been reliably positive which is consistent with the Fisher Hypothesis. It is appropriate therefore to examine the relation between stock returns and inflation in other countries besides the U.S. and the U.K.

Two studies in the finance literature have investigated the relation between

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[1] Studies with bonds support the Fisher Hypothesis. See Gibson [15, 16] and Fama and Schwert [9], for example.

stock prices and inflation in other countries using cross-sectional analysis: Branch [3] and Cagan [4]. Branch reported that stocks are a partial inflation hedge and Cagan concluded stocks are an inflation hedge for long-term holdings.

This study finds no significant positive relation between monthly nominal stock returns and expected inflation rates for most of the 26 countries analyzed using time series models. This evidence is not consistent with the Fisher Hypothesis. These findings are presented in the following order. Section I discusses some theoretical considerations and the Fisher hypothesis, Section II explains the data, Section III presents times series results; Section IV compares the time series results with the cross-sectional results reported by Branch [3] and Cagan [4], and Section V concludes the paper with a short summary.

I. Asset Returns and Inflation: The Fisher Hypothesis

The original idea relating the nominal interest rate to expected inflation is commonly attributed to Irvin Fisher. Fisher [11] asserted that the nominal interest rate consists of a "real" rate plus the expected inflation rate. Fisher, an early monetarist, also believed that the real and monetary sectors of the economy are largely unrelated. He hypothesized that the expected real rate is determined by real factors such as the productivity of capital and time perference of savers, and is independent of the expected inflation rate. This hypothesis, known as the Fisher Hypothesis, about interest rates can be generalized to all assets in efficient markets (see Fama and Schwert [9] for a detailed discussion).

The Fisher Hypothesis as stated above is by no means the only hypothesis relating the expected real rate to expected inflation. Mundell [23], for example, uses the Pigou real wealth effect to show that the real rate of interest is negatively related to expected inflation. Santomero [26] shows that changes in the growth rate of the labor force or productivity may give rise to a direct relation between the expected real rate and expected inflation. Furthermore, introducing progressive income taxes may cause further dependencies between the two variables.

Like previous empirical research on this topic, here we test the generalized Fisher hypothesis, which states that the market is efficient and that the expected real return on common stocks and the expected inflation rate vary independently so that, on average, investors are compensated for changes in purchasing power. The tests of this joint hypothesis can be obtained from the estimates of the following regression model:

$$\tilde{R}_a = \alpha + \beta E(\tilde{\pi}_t \,|\, \phi_{t-1}) + \tilde{\epsilon}_t \tag{1.1}$$

where R_t is the nominal return on common stocks and π_t is the inflation rate. The time subscript t denotes returns between the end of time period $t-1$ and the end of time period t. ϕ_{t-1} is the information set that investors use in forming their expectations. E is the mathematical expectations operator.

The regression model in (1.1) estimates the conditional expected value of the stock market return as a function of the expected inflation rate. Therefore, an estimate of β which is statistically indistinguishable from unity is consistent with the hypothesis that the expected nominal return on common stocks varies in one-to-one correspondence with the expected inflation rate, and this implies that common stocks are a complete hedge against expected inflation. Furthermore, since the expected real return on an asset is equal to its expected nominal return less the expected inflation rate, an estimate of β that is indistinguishable from unity is also consistent with the hypothesis that the expected real return on stocks and the expected inflation rate are independent. These tests are presented in Section III following the description of our data.

II. Data

A. *Data Source*

Monthly inflation rates for individual countries from January 1947 to December 1979 are calculated as the percent changes in the consumer price indices reported in *International Financial Statistics* (*IFS*) published by the International Monetary Fund.[2]

Stock market returns are obtained from two sources. *IFS* reports stock market indices for about 26 countries for the period 1/1947–12/1979. These indices include at least 60% of the market value of all shares traded in the most active stock exchange in each country and are averages of daily or weekly closing prices for most countries. If a country reports more than one index, only the index for industrial shares is used to compute stock returns.

The second source of data is *Capital International Perspective* (*CIP*). This Swiss-based investment services firm provides stock market indices based on 1100 share prices listed on the stock exchanges of 18 countries. *CIP* indices represent approximately 60 percent of the total market value of all shares traded in these countries. The fraction of total share value represented by the index for each country ranges from 47% for Singapore to 80% for Norway. Indices are all based on month-end closing prices in local currencies. This data covers the period 12/1958–12/1979.

B. *Statistical Properties of the Data*

Table I presents summary statistics and estimates of the first four autocorrelations for inflation rates and stock market returns for both *IFS* and *CIP* indices.

Monthly inflation rates in almost all countries have positive autocorrelations. However, the inflation rates for Belgium, Denmark, the Netherlands, South Africa, and Venezuela appear to have very low first order autocorrelation.

IFS stock returns also have positive autocorrelation. With the exception of Denmark, higher order autocorrelations are not significantly different from zero. Positive first order autocorrelation may be explained by the fact that these indices are constructed from daily or weekly average closing prices. (See Working [28]). Autocorrelations are much lower for the *CIP* return series. Only Austria, Denmark, and Norway have serially correlated stock returns. Although not reported,

[2] There might be some objections to using the consumer price index to represent the true erosion in the purchasing power. We cannot offer any solution to the problems in constructing a true cost of living index. We did use, however, wholesale price indices for some countries. Wholesale and consumer price indices are very highly correlated, and the results do not change materially. In some countries the consumer price index includes a high percent of imported goods. Generally, indices for domestic goods and imported goods have a high correlation.

Table I

Monthly Inflation Rates and Nominal Stock Returns: Summary Statistics

	Inflation Rates January 1947–December 1979[a]						Stock Market Returns: IFS Indices January 1947–December 1979						Stock Market Returns: CIP Indices January 1947–December 1979					
	Mean	σ	ρ_1	ρ_2	ρ_3	ρ_4	Mean	σ	ρ_1	ρ_2	ρ_3	ρ_4	Mean	σ	ρ_1	ρ_2	ρ_3	ρ_4
Australia[b]	1.576	1.718	.517*	.403*	.306*	.491*	.466	3.375	.356*	.089	.98	−.004	.754	5.679	.067	.062	.038	−.079
Austria	.642	3.240	.210*	.241*	.078	.007	.564	4.095	.305*	.193*	.078	.073	.459	3.177	.315*	.219*	.034	−.004
Belgium	.305	1.132	.023	.035	.063	.228*	.153	3.695	.049	−.037	−.057	.050	.156	3.332	.090	−.073	.115	−.053
Canada	.375	.550	.346*	.255*	.311*	.336*	.668	4.183	.172*	−.007	.024	.024	.705	4.334	.099	−.073	.115	.015
Denmark[b]	1.438	1.526	.086	.282*	.016	.033	.376	3.012	.293*	.221*	.171*	.134*	.247	3.335	.291*	.183*	.139*	.147*
Finland	.671	1.198	.292*	.226*	.200*	.235*	.787	4.726	.282*	.021	.000	.045						
France	.620	1.666	.597*	.392*	.281*	.128*	.732	6.003	−.054	−.015	.132*	−.082	.458	5.609	.024	−.012	.039	−0.13
Germany	.254	1.200	.129*	.016	.079	.088	.658	4.248	.377*	.106	.067	.104	.428	5.051	.169*	.016	−.018	.045
India	.425	1.470	.391*	.291*	.172*	−.034	.301	4.931	.163*	−.006	−.036	.002						
Ireland[b]	1.888	2.032	.325*	.176*	.373*	.510*	.707	6.099	.316*	.093	.156*	−.017						
Israel	1.296	2.268	.410*	.337*	.303*	.327*	1.591	6.701	−.018	.152*	.030	.044						
Italy	.562	1.506	.042	.211*	.143*	.096	.554	6.707	.244*	−.043	−.118*	.015	.229	6.312	.121	−.099	−.120	.017
Japan	.886	2.803	.455*	.324*	.320*	.383*	1.607	7.051	.243*	.022	−.065	.031	.992	4.967	.048	.60	−.036	.018
Netherlands	.421	.991	.021	−.060	.080	−.089	.305	3.903	.268*	.105*	−.014	.000	.246	4.450	.104	.002	.061	−.078
New Zealand[b]	1.607	1.399	.600*	.466*	.444*	.475*	.378	2.847	.250*	.179*	.102	.032						
Norway	.429	.774	.074	.135*	.131	.026	.319	4.987	.114	.032	.020	.006	.686	5.754	.175*	−.022	.194*	.000
Peru	1.125	1.936	.208*	.245*	.233*	.220*	.263	3.771	.039	.100	.129*	.100						
Philippines	4.24	1.959	.206*	−.037	.016	.057	.134	4.407	.275*	.120*	.094	.019						
Singapore[c]	.520	1.335	.362*	.271*	.239*	.307*							1.505	10.170	.206*	−.065	−.102	.031
South Africa	.441	.929	.009	.082	.068	.073	.401	4.025	.404*	.075	.064	.028						
Spain	.692	.836	.440*	.269*	.196*	.199*	−.188	3.940	.124*	−.063	.061	.041	.3183	4.203	.040	−.041	.104	.059
Sweden[b]	1.301	1.543	.168*	.126*	.086	.118*	.503	3.722	.092	−.061	.071	.032	.447	4.173	.027	−.085	.111	.015
Switzerland	.245	.537	.033	.139*	.102	.042	.301	4.326	.163*	−.130*	−.021	.157*	.519	5.289	.060	−.128*	.107	.034
UK	.558	.816	−.263*	.250*	.218*	.216*	.507	5.318	.259*	.016	.010	.074	.743	6.543	.150	−.072	.139	.018
USA	.325	.516	.157*	.314*	.283*	.325*	.581	3.347	.223*	−.017	.071	.077	.332	4.016	.035	−.046	.059	.064
Venezuela	.312	1.422	.010	.058	.040	−.025	.210	2.905	.159*	.096	.095	.087						

[a] See Table II for the time period covered for individual countries.

[b] Quarterly observations for inflation rates only.

[c] Data is for January 1970–December 1979. Inflation rates are from *International Financial Statistics* (*IFS*). Stock market returns are from *IFS* and *Capital International Perspective* (*CIP*). Means and standard deviations (σ) are multiplied by 100.

* Sample autocorrelation is at least two standard deviations to the left or to the right of its expected value under the hypothesis that the true autocorrelation is zero.

the values of skewness and *studentized* ranges for both stock return series are consistent with the normal distribution.

While *IFS* indices do not measure monthly rates of return accurately, they are available for a much longer period than *CIP* indices. We therefore use both in our analysis.

III. Time Series Regression Results

In order to investigate the relation between nominal stock returns and inflation, the regression model in (1.1) is estimated by using three different estimates of the expected inflation rate. First, we use the contemporaneous inflation rates as proxies for expected inflation. Second, we decompose inflation into expected and unexpected components by ARIMA models. Finally, short-term interest rates are used as predictors of inflation. Most of the previous research uses one of these methods to estimate expected inflation. Results in this section, thus, should be comparable to those reported in the literature.

A. *Contemporaneous Rates as Proxies for Expected Inflation*

Regressions of stock returns on contemporaneous inflation rates are summarized in Table II for 25 countries for the period January 1947–December 1979.[3] Realized values are used under the assumption that expectations are rational. Rationality implies that the expectations of inflation and the stock returns in period t are based upon all relevant information available as of the beginning of the period. Rationality also requires that prediction errors have zero means and are serially uncorrelated. Properties of the regression estimates using realized values will depend, naturally, on the properties of these prediction errors. We investigate this problem in detail after a brief discussion of the results in Table II.

For most countries, the relation between stock returns and inflation is not statistically significant. The explanatory power of all the regressions is low. Durbin-Watson statistics for several regressions are low, due to the positive serial correlation in the stock return data. Adjusting the regressions for first-order autocorrelation by using Cochrane-Orcutt transformation did not alter the results in Table II. The most striking feature of the findings, however, is the lack of a statistically positive relation between nominal stock returns and inflation. Only six of the estimates of β in (1.1) are reliably different from zero, and of those six, four have negative signs. Israel and the U.K. are the two countries which have statistically positive estimates of β. The U.K. is the only country with an estimate of β that is not reliably different from 1.0 among a sample of 25 countries. Furthermore, of those 25 countries, 18 of the estimates of β are negative.

A particularly interesting (or troublesome) result is the statistically significant negative β estimates for some of the industrialized countries, such as Germany and Switzerland. Most other industrialized countries such as Australia, Canada,

[3] The exact time period covered varies due to the availability of data for each country. One may also raise the question about the reliability of *International Financial Statistics* data series before the period 1950. Regressions in Table IV have also been run for the following time periods: 1/1949–12/1979, 1/1950–12/1979 and 1/1953–12/1979. The results do not change materially.

Table II
Stock Returns and Inflation OLS Estimates Using *IFS* Stock Indices
$$\tilde{R}_t = \alpha + \beta\tilde{\pi}_t + \tilde{e}_t$$

	α	β	$t(\alpha)$	$t(\beta)$	R^2	F	D.W.	Period
Australia[a]	2.209	−.467	2.47	−1.22	0.117	1.480	1.76	1/47–12/79
Austria	.473	.188	2.17	1.48	.0057	2.192	1.38	1/48–12/79
Belgium	.157	−.013	.81	−.08	.0000	.005	1.89	1/47–12/79
Canada	.832	−.437	3.27	−1.14	.0033	1.306	1.60	1/47–12/79
Denmark[a]	1.664	−.005	2.53	−1.06	.0088	1.132	1.37	1/47–12/79
Finland	.840	−.079	3.08	−.40	.0004	.158	1.42	1/47–12/79
France	.630	.165	1.95	.91	.0021	.836	2.11	1/47–11/79
Germany	.957	−1.124	3.48	−2.33	.0176	5.425	1.23	1/50–12/79
India	.374	−.195	1.45	−1.15	.0034	1.325	1.67	1/47–12/79
Ireland[a]	2.737	−.285	1.16	−.23	.0013	.053	1.58	7/68–6/79
Israel	.814	.576	1.74	3.30	.0406	10.906	2.07	1/55–12/79
Italy	.747	−.672	2.50	−3.12	.0272	9.744	1.61	1/50–12/79
Japan	1.720	−.130	4.63	−1.02	.0026	1.046	1.51	1/47–12/79
Netherlands	.317	−.030	1.49	−.15	.0001	.022	1.46	1/47–12/79
New Zealand[a]	1.176	−.050	2.20	−.47	.0017	.221	1.51	3/47–12/79
Norway	.192	.298	.68	.93	.0022	.872	1.76	1/47–12/79
Peru	.223	.037	.96	.33	.0003	.107	1.87	1/47–12/79
Philippines	.144	−.015	.52	−.09	.0000	.008	1.45	5/56–12/79
South Africa	.404	−.007	1.80	−.03	.0000	.001	1.18	1/47–11/79
Spain	−.040	−.224	−.15	−.92	.0023	.839	1.75	1/47–11/79
Sweden[a]	.014	.007	2.38	1.43	.0156	2.039	1.69	1/47–12/79
Switzerland	.502	−.818	2.11	−2.03	.0103	4.121	1.69	1/47–12/79
UK	.121	.705	.37	2.14	.0116	4.575	1.47	6/47–12/79
USA	.696	−.357	3.50	−1.10	.0030	1.202	1.56	1/47–12/79
Venezuela	.282	−.241	1.88	−2.34	.0140	5.485	1.71	1/47–12/79

[a] Quarterly observations.

Denmark, Japan, and the U.S. also have negative regression coefficients, yet not reliably different from zero.[4]

Equation (1.1) is re-estimated with stock returns from the *CIP* indices for the period 1/1959–12/1979. The regression results are reported in Table III. The results are, in general, qualitatively similar to the ones with *IFS* data in Table II. Out of fourteen countries, there are four β-estimates which are reliably different from zero, and three of those are negative. Again, only the U.K. has a regression coefficient that is not reliably different from 1.0. These regressions do not suffer

[4] The regression results for the U.S. are somewhat different for this period than those reported by Fama and Schwert and Nelson for later periods. In order to check the accuracy of *IFS* data, we have run the same regression in Table II for the U.S. with the stock returns on an equally weighted portfolio of all New York Stock Exchange stocks from Center for Research in Security Prices of University of Chicago and inflation rates from NBER data. These results are also very similar to the ones in Table II. For the period 1/1947–12/1979 the regression result is as follows: $R_t = .001 - .807\pi_t$ with $t(\alpha) = 3.20$, $t(\beta) = -1.35$, $R^2 = .0042$, and D.W. = 1.80.

Results for the 1/1953–7/1979 are as follows: $R_t = .015 - 2.232\pi_t$ with $t(\alpha) = 3.9$, $t(\beta) = -2.69$, $R^2 = 0.221$, D.W. = 1.77 with NYSE stock returns and NBER inflation data, and $R_t = .816 = 1.090\pi_t$ with $t(\alpha) = 3.54$, $t(\beta) = -2.42$, $R^2 = .0143$ and D.W. = 1.63 with the *IFS* data.

These differences may stem from the differences in the composition of stock market indices. We did not detect any discrepancies between the inflation series from NBER data and *IFS* data.

Table III

Stock Returns and Inflation: OLS Estimates using *CIP* Stock Indices
January 1959–December 1979
$\tilde{R}_t = \alpha + \beta \tilde{\pi}_t + \tilde{e}_t$

	α	β	$t(\alpha)$	$t(\beta)$	R^2	F	DW
Austria	.439	.041	2.05	.22	.0002	.05	1.36
Belgium	.150	.036	.55	.08	.0000	.01	1.81
Canada	.841	−.632	2.40	−1.10	.0049	1.22	1.88
France	.438	−.004	.82	−.01	.0000	.00	1.92
Germany	.621	−.656	1.65	−.99	.0039	.98	1.67
Italy	.476	−.443	1.08	−1.57	.0099	2.49	1.78
Japan	.907	.017	2.51	.05	.0000	.00	1.89
Netherlands	.130	.232	.41	.73	.0022	.54	1.78
Norway	.442	.601	1.00	1.13	.0052	1.29	1.63
Singapore[a]	1.862	−.679	1.86	−.09	.0080	.93	1.62
Spain	.909	−.769	2.54	−2.49	.0245	6.25	1.97
Sweden	.419	.010	1.27	.03	.0000	.00	1.93
Switzerland	1.043	−1.527	2.66	−2.34	.0216	.550	1.89
UK	.044	1.037	.08	2.05	.0165	4.18	1.68
USA	.994	−1.767	2.92	−2.95	.0337	8.96	1.97

[a] Results are for January 1970–December 1979 period.

from the autocorrelation problem present in the *IFS* data due to the different nature of the price quotation. Durbin-Watson statistics are consistently higher. In spite of the differences in the construction of indices and time periods between two sets of regressions in Tables II and III, results are quite similar and they are not favorable to the Fisher hypothesis in general. We, therefore, report results using *CIP* indices for the remainder of the paper and only indicate differences with results using *IFS* data.

One possible explanation for the lack of positive relation between stock returns and inflation could be the errors-in-variables problem. Following Nelson [24], suppose that observed stock returns and observed inflation are related to their ex ante counterparts with error terms u_t and v_t respectively.

$$\tilde{R}_t = E(R_t \mid \phi_{t-1}) + \tilde{u}_t \tag{3.1}$$

and

$$\tilde{\pi} = E(\pi_t \mid \phi_{t-1}) + \tilde{v}_t \tag{3.2}$$

The estimates of the regression model in (1.1) will be biased. The probability limit of the least squares estimator $\tilde{\beta}$ will be (see Levi [19] and Theil [27]):

$$P \lim \tilde{\beta} = \beta \left[\frac{\sigma^2(\pi) + \operatorname{cov}(v_t, u_t)}{\sigma^2(\pi) + \sigma^2(v)} \right] \tag{3.3}$$

If the prediction errors u_t and v_t are uncorrelated, β estimates will be biased towards zero. Since $\sigma^2(v)$ is smaller than $\sigma^2(\pi)$, measurement errors alone cannot explain the predominantly negative estimates of $\tilde{\beta}$.[5] On the other hand, if the

[5] This statement is based upon our results from ARIMA models which we use to decompose the inflation rates into the expected and unexpected components.

covariance between the two prediction errors is negative, that is, the market reacts negatively to the unexpected inflation, the regression slope would be depressed further and could even be negative. Regressing stock returns on the past inflation rates, however, should eliminate the bias due to the negative covariance term in (3.3), since past inflation rates contain no new information for the market.

Multiple regressions of stock market returns on the lagged inflation rates of π_{t-1}, π_{t-2}, π_{t-3} and π_{t-4} are presented in Table IV. Again, these results are very similar to those presented so far. Furthermore, with the exception of the U.K., now the sum of the regression coefficients is negative. It is difficult to reconcile these predominantly negative estimates of β with the Fisher hypothesis.

There is another set of questions related to the timing of the consumer price index measurements, their public announcement, and the actual rate of flow of information to the market. Consumer price indices are not end-of-month indices like stock price indices. Their various components are measured at different times of the month and public announcements are not made until almost the second half of the following month in almost all countries. Furthermore, long delays in public announcements are not unusual for many countries. Although these announcements may convey little additional information to the market beyond what is available currently from direct observations by market participants or other sources, these questions do suggest, however, the possibility that lagged and lead inflation rates may convey some information. In order to account for this possibility, we experimented with regressions of stock returns on individual leads and lags in the inflation rate, as well as other forms of distributed lag and lead models. For all countries, the lead coefficients are less important than the lag coefficients, but none of the distributed lag and lead models add additional insight to the results already presented and, therefore, they are not reported.

B. ARIMA *Models of Expected Inflation*

It is possible that the regression results may be more favorable to the Fisher hypothesis if we have a better proxy for expected inflation than the contemporaneous rate. Furthermore, one can investigate the adjustment of the market to changes in the unexpected inflation rate if actual changes in inflation rates could be decomposed into unexpected and expected components. We experimented with ARIMA models to generate expected and unexpected components of inflation by using procedures developed by Box and Jenkins [2]. Inflation forecasts from ARIMA models are used as estimates of expected inflation, and the forecast errors are used as the unexpected component of inflation rates. A sample run of these experiments is presented in Table V for the period 1/1959–12/1979 with *CIP* data. As in the case of simpler time series models, results are not consistent with the Fisher hypothesis. One noticeable difference here is the reliably positive coefficient for the unexpected inflation rate for the U.K.[6]

Results, however, are not very robust with respect to the particular ARIMA model that is chosen. The ARIMA models in Panel B of Table V are selected on

[6] Dividend yield is availabel for *CIP* returns for the period 1/1970–1/1979. Adjustment for dividend yields does not alter the rankings of returns.

Table IV

Stock Returns and Lagged Inflation Rates: OLS Estimates Using *CIP* Indices
January 1959–December 1979

$$\tilde{R}_t = \alpha + \beta_1\tilde{\pi}_{t-1} + \beta_2\tilde{\pi}_{t-2} + \beta_3\tilde{\pi}_{t-3} + \beta_4\tilde{\pi}_{t-4} + \tilde{e}_t$$

	α	β_1	β_2	β_3	β_4	$\Sigma\beta$	$t(\alpha)$	$t(\beta_1)$	$t(\beta_2)$	$t(\beta_3)$	$t(\beta_4)$	$t(\Sigma\beta)$	R^2	F
Austria	.706	.040	.069	−.398	−.373	−.660	2.71	.22	.36	−2.07	−1.97	−1.44	0.303	1.94
Belgium	.660	−.630	.149	−.454	−.328	−1.263	1.99	−1.41	.33	−1.01	−.73	−1.91	.0209	1.32
Canada	.779	.451	.467	−1.201	−.157	−.438	1.80	.73	.77	−1.97	−.26	−.50	.0180	1.13
France	.637	.215	−.533	.611	−.705	−.412	.91	.26	−.68	.78	−.87	−.35	.0069	.43
Germany	1.000	−.306	.581	−1.583	−.681	−1.991	2.15	−.46	.87	−2.38	−1.05	−1.71	.0896	2.04
Italy	.705	−.152	−.375	−.090	−.230	−.830	1.23	−.31	−1.18	−.30	−.77	−1.27	.0093	.59
Japan	1.614	−.635	−.229	−.167	−1.93	−1.226	3.57	−2.10	−.76	−.56	−.65	−2.12	.0239	1.51
Netherlands	.445	−.139	−.266	−.214	.154	−.466	1.11	−.44	−.85	−.68	.49	−.73	.0064	.40
Norway	1.665	−.422	−.964	−.324	−.315	−2.027	2.79	−.79	−1.83	−.62	−.60	−2.01	.0195	1.23
Spain	1.681	−.997	−.523	.018	−.216	−1.718	3.89	−3.03	−1.51	.05	−.66	−3.92	.0757	5.06
Sweden	.906	.472	−.621	.229	−.105	−.970	2.01	−1.19	−1.56	.58	−.26	−1.29	.0169	1.06
Switerland	.956	−.462	.642	−.453	−.997	−1.270	1.96	−.69	.96	−.68	−1.50	−1.12	.0161	1.01
UK	.558	−.691	.169	1.292	−.556	.213	.92	−1.21	.29	2.24	−.98	.30	.0264	1.66
USA	.832	−.587	1.000	−1.818	.040	−1.364	2.06	−.83	1.49	−2.70	.06	−1.62	.0465	3.01

$\Sigma\beta$ is the sum of lagged coefficients β_1 through β_4. $t(\Sigma\beta)$ is the t-statistic for the sum of the coefficients.

Table V

Stock Returns and Expected and Unexpected Inflation
January 1959–December 1979

	Panel A: Regression – $\tilde{R}_t = \alpha + \beta_1 E(\tilde{\pi}_t) + \beta_2[\tilde{\pi}_t - E(\pi_t)] + \tilde{\epsilon}_t$							Panel B: ARIMA models for inflation					
									Nonseasonal		Seasonal		
	α	β_1	β_2	$t(\alpha)$	$t(\beta_1)$	$t(\beta_2)$	$\tilde{R}^2$	ARIMA Model	AR1	MA1	AR1	MA1	AR2
Austria	.511	−.213	−.024	1.70	−.32	−.15	.0000	(1, 0, 1)	.450	.677			
									(.160)	(.135)			
Belgium	.449	−.843	.443	1.17	−1.06	.91	.0010	(0, 1, 1)		.907			
										(.025)			
Canada	.234	.892	−1.034	.41	.76	−1.50	.0033	(0, 1, 1)		.992			
										(.006)			
France	.027	.449	−.499	.03	.28	−.53	.0000	(0, 1, 1)		.935			
										(.021)			
Germany	.267	−1.246	.561	.20	−.28	.66	.0000	(0, 1, 1)		.992			
										(.001)			
Italy	.471	−.447	−.447	.88	−.73	−1.42	.0022	(2, 0, 1)	.604	.943			.396
									(.016)	(.023)			(.026)
Japan	1.950	−1.899	.112	2.85	−1.84	.36	.0081	(0, 1, 1)		.886			
										(.059)			
Netherlands	.032	.444	.184	.07	.62	.53	.0000	(1, 0, 1)			.809	.507	
											(.071)	(.103)	
Norway	−.870	3.232	−.082	−1.33	2.96	−.14	.0282	(1, 0, 0)			.926		
											(.015)		
Spain	2.536	−2.660	−.233	5.05	−4.96	−.70	.0871	(0, 1, 1)		.918			
										(.025)			
Sweden	.331	−1.398	.277	1.19	−.88	.87	.0000	(0, 1, 1)		.966			
										(.013)			
Switzerland	1.114	−2.068	−1.077	2.27	−1.98	−1.43	.0181	(0, 1, 1)(0, 1, 1)		.869		.853	
										(.049)		(.045)	
UK	−.009	.860	1.364	−.01	.91	2.43	.0160	(0, 1, 1)		.895			
										(.028)			
USA	.629	−.813	−2.321	1.27	.77	−3.07	.0320	(0, 1, 1)		.896			
										(.028)			

Notes: $E(\pi_t)$ is expected inflation which is forecasted by the ARIMA model for each country.
π_t is the observed inflation at time t.
$\pi_t - E(\pi_t)$ designates the unexpected component of inflation.
Figures in the parentheses are the standard deviations for the parameter estimates of the ARIMA models. Seasonal components are based on a lag of 12 months.
Data Source: *CIP* for stock returns.

the basis of minimum sum of squared residuals which are serially uncorrelated. A difficulty with using the ARIMA models to forecast inflation for longer periods is that for most of the countries, inflation rates are more volatile in the 1970s than in the 1960s. There appears to have been a structural shift in the inflationary process in many countries; this partially accounts for the lack of robustness of results when the ARIMA models are fitted for longer periods.

C. *Short Term Interest Rates as Predictors of Inflation*

Fama [7] has shown that Treasury Bill returns can be used as predictors of inflation in the U.S. We employ Fama's technique to predict quarterly inflation rates from 90-day Treasury Bill or equivalent money market returns. The interest rate data are available from *Financial Statistics* published by the O.E.C.D. for a number of countries. Like Fama, we assume that 90-day Treasury Bill yield observed at the end of a quarter contains the market's assessment about the expected inflation during the next quarter. Formally, we estimate the expected and unexpected inflation from the following regression model.

$$\tilde{\pi}_t = \alpha + \beta I_{t-1} + \tilde{e}_t \tag{3.4}$$

where I_{t-1} is the 90-day Treasury Bill yield quoted at the end of quarter $t - 1$ and maturing at the end of quarter t, and π_t is the inflation rate observed during quarter t.

The regression results for the model in (3.4) are shown in Table VI, Panel B. Regression coefficients are all positive and significant for most countries. Furthermore, many are indistinguishable from unity. A more detailed discussion of the interest rate-inflation model in (3.4) is in Fama [7, 8] and Fama and Schwert [9]. For our purposes, the important empirical finding is that estimates of Equation (3.4) are consistent with the proposition that changes in interest rates, I_t, correspond to changes in the expected inflation rate. We, therefore, use predictions from the model in (3.4) as expected inflation and the prediction errors as unexpected inflation.

Regressions of stock returns on expected and unexpected inflation are presented in Table VI, Panel A. Regressions are estimated in Zellner's [29] seemingly unrelated regression model (SURM). The F-test for the joint significance of regression coefficients for both expected and unexpected inflation indicates that they are reliably different from zero. Furthermore, all regression coefficients for the expected inflation rate are negative. These results indicate a stronger negative relation between stock returns and expected inflation than our previous findings, and they are again very difficult to reconcile with the Fisher hypothesis. Another different finding here is for the U.K. The regression coefficient is negative for the expected inflation rate and positive for the unexpected inflation rate.[7]

[7] These results are not exactly comparable to our findings in Sections III.A. and III.B., because of the differences in time period and the use of quarterly data here. Furthermore, if there is a negative relation between changes in the interest rates and common stock returns, our results may be reflecting this rather than the relation between stock returns and expected inflation. The regression model in (3.4) is used under the assumption that the real interest rate is constant or independent of the expected inflation rate. If this is not true, the use of interest rates as proxies for expected inflation is questionable and the results should be, therefore, interpreted accordingly.

Table VI

Stock Returns and Expected and Unexpected Inflation Using Interest Rates as Predictors of Inflation[a]
January 1965–December 1979

	Panel A: Regression: $\tilde{R}_t = \alpha + \beta E(\tilde{\pi}_t) + \delta[\tilde{\pi}_t - E(\tilde{\pi}_t)] + \tilde{e}_t$						Panal B: Short Term Interest Rates as Predictors of Inflation[b]: $\tilde{\pi}_t = \alpha + \beta I_{t-1} + \tilde{e}_t$					
	α	β	δ	$t(\alpha)$	$t(\beta)$	$t(\delta)$	α	β	$t(\alpha)$	$t(\beta)$	R^2	DW
Austria	.023	−1.596	.086	1.02	−.81	.36	−.002	.878	−.19	1.13	.0168	2.89
Belgium	.021	−1.810	.342	1.76	−2.20	.76	−.002	.924	−.61	5.32	.2740	1.26
Canada	.021	−.756	−1.497	1.33	−.67	−2.12	−.002	1.003	−.88	6.59	.3673	1.15
Denmark	.044	−2.157	−.608	1.98	−1.87	−1.19	−.002	.770	−.40	3.98	.1747	2.30
France	−.005	.501	−.065	−.23	.38	−.06	−.010	1.316	−3.36	8.71	.5028	1.94
Germany	.044	−4.801	.766	1.46	−1.43	−1.14	.003	.337	1.29	1.86	.0444	2.15
Italy	.006	−.757	−.518	.26	−.75	−1.23	−.008	1.461	−1.15	3.96	.1731	2.63
Japan	.100	−4.418	.451	2.69	−2.21	.77	.001	.831	.20	2.51	.0779	2.07
Netherlands	.036	−2.624	−.251	.94	−.98	−.65	.009	.450	2.37	1.36	.0241	1.91
Spain	.091	−3.467	−1.406	5.18	−5.28	−3.30	−.011	1.671	−1.76	5.88	.3157	1.69
Sweden	.062	−3.712	.474	3.13	−3.08	.84	−.009	1.363	−1.62	4.23	.1932	2.22
Switzerland	.058	−5.237	.236	2.70	−2.78	.37	−.002	1.137	−.67	3.17	.1184	2.14
UK	.037	−1.444	1.302	1.89	−1.84	2.27	−0.12	1.781	−2.40	6.88	.3870	1.92
USA	.031	−2.241	−1.756	2.38	−2.77	−1.91	−.008	1.621	−4.98	12.22	.6657	1.92
Weighted R^2		.0859										
F-values for:												
H_0: $\beta_1 = \beta_2 = \cdots = 0$	4.960	H_0'': $\beta_1 = \beta_2 \cdots \beta_k$		1.617								
H_0': $\delta_1 = \delta_2 = \cdots = 0$	2.134	H_0''': $\delta_1 = \delta_2 = \cdots \delta_k$		2.200					$k = 1, 2, \cdots, 14$			

[a] Quarterly observations. [b] π_t is the observed inflation rate for the quarter t; I_{t-1} is the 90-day T-Bill or equivalent money market rate observed at the end of quarter $t - 1$; $E(\pi_t)$ is the expected inflation rate which is predicted by the T-Bill regression in Panel B. $\pi_t - E(\pi_t)$ is the unexpected component of inflation. Regression models in Panel B are estimated by the SURM technique. The degrees of freedom for the F-test are (14,1036) and the null hypotheses are rejected at the 5% confidence level.

Data source: *CIP* for stock market returns and *Interest Rates* and *Financial Statistics*, OECD Publications, Washington, DC.

We also test the equality of regression coefficients between countries. The F-test, shown at the bottom of Table VI, rejects this hypothesis. The effect of inflation on common stock returns appears to vary among countries.[8]

IV. Cross-Sectional Results

The evidence in Section III does not support the joint hypothesis that the market is efficient and that the expected real return on common stocks and the expected inflation rate vary independently. These results are puzzling because in many countries the expected return on stocks would at times have been below the risk-free rate or negative. It appears that either the expected real rate of return on common stocks is negatively related to expected inflation for some economic reasons yet to be explained, or markets fail to impound all the available information about future inflation into stock prices.

Mundell [23] has claimed a negative relation between the expected real rate of interest and expected inflation. More recently Santomero [26] has argued that, in the context of neoclassical monetary growth theory, an increase in the growth rate of the money supply will cause a change in the expected real rate. The expected inflation rate in this framework is equal to the difference between the growth rate of the money supply and the rate of factor augmentation, which is the rate of increase in the natural labor force and technological change. The sign of the change in the expected real rate with respect to changes in the growth rate of money supply, according to Santomero, depends on the change in the rate of factor augmentation with respect to the change in the growth rate of money supply.

Others, for example Kessel [18] and Lintner [20], suggest different hypotheses about the relation between common stock returns and inflation. French, Ruback, and Schwert [12] provide a comprehensive summary of these views.

Recent empirical work by Garbade and Wachtel [14] and Mishkin [21], for example, does not support the view that the expected real rate is constant and uncorrelated with expected inflation. Most recently, Fama [8] claims that the negative relation between stock returns and expected inflation in the U.S. is largely spurious.

Like others who investigated this topic with the U.S. data, we have no explanation for the lack of a reliable positive relation between common stock returns and the expected inflation in most countries.[9] In this section, we compare the time series results in the last section with the cross-sectional studies by

[8] We also re-estimated the model (1.1) for ten- and five-year subperiods in order to investigate the stability of the stock return-inflation relation and time. Results are, in general, similar to those reported in Table II. Subperiods results, however, do not indicate as strong a relation between stock returns and inflation as found in the total sample period. We cannot reject the null hypothesis that *all* β-estimates are zero for the ten-year subperiods and two of the five-year subperiods. F-tests developed by Chow [5] indicate no reliable structural change between the two ten-year subperiods for any country, with the exception of Germany and the U.K. Regression coefficients, on the other hand, are not stable for the five-year subperiods with the exception of Norway.

[9] Recently several researchers have offered an alternative explanation, "economic enigma" as Fama and Schwert phrase it. Studies by Modigliani and Cohn [22], Fama [8], Friend and Hasbrouck [13], and Cohn and Lessard [6] are the most recent examples.

Branch [3] and Cagan [4] who report a positive relation between stock returns and inflation across countries. Branch reports that "stocks appear to be a partial hedge, but not a complete long-run inflation hedge." Cagan concludes that "[a] comprehensive group of stocks will protect against inflation, apart from hyper-inflation or wartime devastation, but not concurrently, . . . [S]tocks, if broadly selected, passed the test as an inflation hedge only for long term holdings."

A visual description of our data is presented in Figure 1. The horizontal axis represents the average monthly inflation rate and the vertical axis represents the average monthly nominal stock returns for the period 1/1947–12/1979 for 25 countries. Visual inspection of the data suggests a positive historical relation between average stock returns and average inflation among countries.

Results of fitting a regression line to the data in Figure 1 are given in Table VII. In Panel A, the mean stock returns of 25 countries for the period 1/1947–12/1979 are regressed on the mean inflation rate for the same period. The regression coefficient is .789 with a t-ratio of 3.00. Panel B presents regression results for a group of 16 industrialized countries with the most developed capital markets. The regression coefficient is now 1.425.

Regressions are re-estimated for two equal subperiods. Regression coefficients

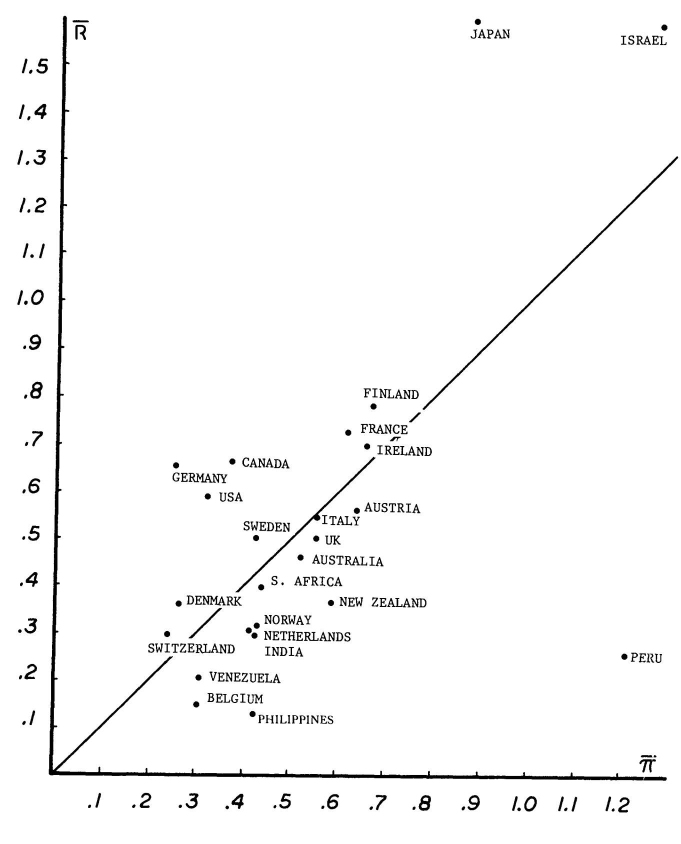

Figure 1. Scatter Diagram of Average Monthly Nominal Stock Returns and Inflation Rates

Table VII

Cross-Sectional Regressions of Average Monthly Nominal Stock Returns on Average Monthly Inflation Rates

$$\bar{R}_i = \gamma_0 + \gamma_1 \bar{\pi}_i + e_i$$

	Statistic					
Period	γ_0	γ_1	$t(\gamma_0)$	$t(\gamma_1)$	R^2	F
Panel A: 25 Countries[a]						
1/1947–12/1979	.087	.789	.55	3.00	.2812	9.00
1/1947–12/1963	.244	1.159	1.10	2.50	.2213	6.25
1/1964/12/1979	.057	.453	.40	2.40	.2003	5.76
Panel B: 16 Industrialized Countries[b]						
1/1947–12/1979	−.116	1.425	−.65	4.06	.5419	16.54
1/1947–12/1963	.292	1.352	1.48	3.35	.4635	11.23
1/1964–12/1979	−.201	.950	−.73	1.99	.2214	3.98

[a] 25 countries are shown in Table I. Singapore is not included.

[b] 16 countries are: Australia, Austria, Belgium, Canada, Denmark, France, Germany, Ireland, Italy, Japan, Netherlands, Norway, Sweden, Switzerland, UK, and USA.

$\bar{R}_i$ and $\bar{\pi}_i$ are the arithmetic means of monthly nominal stock returns and inflation rate for the i^{th} country respectively for each time period given in Column 1. Data source: *IFS*.

are positive for both subperiods, and smaller in the second subperiod. These results are presented in Panel B. The cross-sectional regressions are also repeated for ten- and five-year subperiods. Regression coefficients are not significant for these subperiods except for the 1970–79 period which has a reliably positive coefficient.

These results, with a longer data series, are similar to those reported by Branch and Cagan. Countries with high inflation rates are associated with high nominal stock returns and this appears to be in contrast to the time series results. These seemingly contradictory results, however, can easily be explained as follows. During the 1947–63 period, inflation was slowing down from the peak levels of the postwar period, while the mean stock returns were above the inflation rate for most countries. During the 1964–79 period, however, inflation was rising and the mean stock returns were less than the mean inflation rate in every country except Canada and South Africa. Cross-sectional results simply show that mean stock returns have been proportional to the mean inflation rates across the countries, even though the stock returns have been declining with rising inflation in most countries.

A simple example can further illustrate the cross-sectional results. The average monthly stock returns for the U.S. were .830 percent, and the average inflation rate was .180 percent during 1947–63. Corresponding figures were .940 and .640 percent for Finland for the same period. During 1964–79, the average stock returns for the U.S. were .300 percent and the inflation rate was .460 percent. The figures were .600 and .698 for Finland. Even though the real returns have been negative during the last fifteen years, the regression lines passing through the mean stock returns and the mean inflation rates for the U.S. and Finland are positive for both periods.[10] Cross-sectional results indicate this phenomenon, while time series results account for the negative or the lack of positive relation between stock returns and inflation over time in most countries. Cross-sectional regressions, therefore, are not proper tests for the properties of common stocks as a hedge against inflation in each country, even though it is interesting to observe that average stock returns have been historically proportional to the level of inflation experienced across the countries. This is true even at times when real returns on common stocks have been negative for most countries.

V. Conclusions

This paper investigates the relation between stock returns and inflation in 26 countries.

We test the generalized Fisher hypothesis, which states that real rates of return on common stocks and expected inflation rates are independent and that nominal stock returns vary in a one-to-one correspondence with expected inflation. Using time series regressions, we do not find a reliable positive relation between nominal stock returns and inflation rates for the period 1/1947–12/1979. Regression coefficients are predominantly negative. Furthermore, we find that the stock return-inflation relation is not stable over time and that there are differences among countries.

We also observe that countries with higher rates of inflation generally have higher nominal stock returns, while real rates in most countries have been declining since the mid 1960s. It appears that the relation between common stock returns and inflation in other countries is as puzzling as the findings in the U.S.

REFERENCES

1. Zvie Bodie. "Common Stocks as a Hedge Against Inflation." *Journal of Finance* 31 (May 1976), 459–70.
2. G. E. P. Box and G. M. Jenkins. *Time Series Analysis, Forecasting and Control.* San Francisco: Holden Day, 1970.
3. Ben Branch. "Common Stock Performances and Inflation: An International Comparison." *Journal of Business* 47 (January 1974).
4. Phillip Cagan. "Common Stock Values and Inflation: The Historical Record of Many Countries." *National Bureau of Economic Research Annual Report Supplement*, 1974.
5. G. C. Chow. "Tests of Equality between Sets of Coefficients in Two Linear Regressions: An Expository Note." *Econometrica* 38 (June 1970), 591–605.
6. Richard A. Cohn and Donald Lessard. "Inflation and Stock Returns: International Evidence." Paper presented in AEA meetings, Denver, CO: September 1980.
7. Eugene F. Fama. "Short Term Interest Rates as Predictors of Inflation." *American Economic Review* 65 (June 1975), 269–82.
8. ———. "Stock Returns, Real Activity, Inflation and Money." Center for Research in Security Prices, Working Paper No. 24, December 1980.
9. ——— and G. William Schwert. "Asset Returns and Inflation." *Journal of Financial Economics* 5 (November 1977), 115–46.
10. Michael Firth. "The Relationship Between Stock Market Returns and Rates of Inflation." *Journal of Finance* 34 (June 1979).

[10] These two countries are chosen arbitrarily. They should not imply any presumption about the stability of rankings of the inflation rate through time across countries.

11. Irving Fisher. *The Theory of Interest.* New York, NY: Macmillan, 1930.
12. Kenneth R. French, Richard S. Ruback, and G. William Schwert. "Effects of Nominal Contracting on Stock Returns." The University of Rochester, Managerial Economics Research Center, Rochester, June 1980.
13. Irwin Friend and Joel Hasbrouck. "The Effect of Inflation on the Profitability of Valuation of U.S. Corporations." Rodney L. White Center for Financial Research, The Wharton School, University of Pennsylvania, 1981.
14. Kenneth Garbade and Paul Wachtel. "Time Variation in the Relationship between Inflation and Interest Rates." *Journal of Monetary Economics* 4 (November 1978), 755–65.
15. William E. Gibson. "Price-Expectations Effects on Interest Rates." *Journal of Finance* 25 (March 1970), 19–34.
16. ———. "Interest Rates and Inflationary Expectations." *American Economic Review* 62 (December 1972), 854–6.
17. Jefferey F. Jaffe and Gershon Mandelker. "The 'Fisher Effect' for Risky Assets: An Empirical Investigation." *Journal of Finance* 31 (May 1977), 447–58.
18. Reuben A. Kessell. "Inflation-Caused Wealth Redistribution: A Test of a Hypothesis." *American Economic Review* (March 1956), 128–41.
19. Maurice D. Levi. "Errors in the Variables in the Presence of Correctly Measured Variables." *Econometrica* 41 (September 1973), 985–7.
20. John Lintner. "Inflation and Common Stock Prices in a Cyclical Context." *National Bureau of Economic Research Annual Report,* 1973.
21. Frederic S. Mishkin. "The Real Interest Rate: An Empirical Investigation." University of Chicago Working Paper, September 1980.
22. Franco Modigliani and Richard A. Cohn. "Inflation, Rational Valuation and the Market." *Financial Analyst Journal* 35 (March/April 1979), 24–44.
23. Robert Mundell. "Inflation and Real Interest." *Journal of Political Economy* 71 (June 1963), 280–3.
24. Charles R. Nelson. "Inflation and Rates of Return on Common Stocks." *Journal of Finance* 31 (May 1976), 471–83.
25. Bruno A. Oudet. "The Variation of the Returns on Stocks in Periods of Inflation." *Journal of Financial and Quantitative Analysis* 8 (March 1973), 247–58.
26. Anthony M. Santomero. "A Note on the Interest Rates and Prices in General Equilibrium." *Journal of Finance* 38 (September 1973), 997–1000.
27. Henri Theil. *Principles of Econometrics.* New York, NY: John Wiley, 1971.
28. H. Working. "Note on the Correlation of First Differences of Averages in a Random Chain." *Econometrica* 28 (September 1960), 916–18.
29. Arnold Zellner. "An Efficient Method of Estimating Seemingly Unrelated Regressions and Tests for Aggregation Bias." *Journal of the American Statistical Association* 57 (June 1962), 348–68.