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International Financial Relations Under the Current Float: Evidence from Panel Data

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Abstract

This paper uses multi-country data for the period 1973–1994 to investigate five key equilibrium conditions in international finance—purchasing power parity, the Fisher equation, uncovered interest parity, and the equity-return analogues of the latter two. The results are largely consistent with theoretical expectations. Over the long run, purchasing power parity, uncovered interest parity and the Fisher effect prove to be rather good first approximations. The equity-return relations, though somewhat less so are nevertheless much better behaved than past studies would lead one to expect. Average rates of equity returns keep pace with inflation within countries in almost all instances; across countries, they are positively correlated with average rates of inflation. This is particularly the case when the data period is extended to include earlier decades.

In international finance as in other areas of economics, there are certain key relationships that loom large in our thinking. Like the model of the competitive firm in price theory, these relationships are regarded both as useful empirical first approximations and as points of departure in other, more complex, theoretical analyses.

Skim through any text in international finance (e.g., Levi, 1995; Melvin, 1996; Solnik, 1995) and several such relationships invariably appear: purchasing power parity, in one or several of its guises; the Fisher equation, and its international analogue, uncovered interest parity; and two closely related conditions for equity returns—a one-to-one link between nominal returns and inflation, and equality of exchange-rate adjusted nominal returns among countries. All are in one way or another theoretical offshoots of more fundamental tenets in economics—the law of one price, the homogeneity postulate, or both. And, despite the fact that it is easy to point to theoretical reasons why these relationships might be violated in actual data, their underlying theoretical appeal has been such that violations usually had been treated as if they were the exception rather than the rule.

Over the past two decades, however, some of that attraction waned as these relations became subject to increasing empirical challenge. In each instance, a rather substantial literature reporting results in conflict with the particular relation in question developed.[1] The conclusions that various researchers reached on the basis of these studies were that purchasing power parity had not held; that uncovered interest parity, either due to risk premia or other factors had been systematically violated; that the Fisher effect in bond markets had been incomplete; and that nominal equity returns had borne little or no relation to variations in inflation, and a much less than perfect relationship to one another across countries.

The question this paper addresses is what in each case can be salvaged. To do so, we focus on the long-run properties of these relations, and in particular, since the bulk of the evidence against them has come from recent data, on how well they have held at such horizons during the past several decades. Because over this short span of years the information in any one or a few time series is apt to be quite limited, we use multi-country panel data to gain additional degrees of freedom. These data span 23 OECD countries and the period 1973 to 1994.[2]

The results in the main conform to theoretical expectations. Viewed as long-run relations, the Fisher equation, purchasing power parity, and uncovered interest parity prove to be quite good first approximations. The two equity market relations, are less well-behaved, but nevertheless still broadly in correspondence with theory. The results for uncovered interest parity and the equity-market version of the Fisher equation are particularly worthy of comment. Contrary to virtually all of the literature of the past two decades, we do in fact find a simple relationship between inflation and nominal equity returns both within and across countries. Within countries over long periods, equity returns more than keep pace with inflation in almost all instances; across countries, the two are positively correlated. Our finding that uncovered interest parity approximately holds over the long run implies that whatever the cause of the substantial divergences between exchange-rate changes and interest differentials reported in other studies, its effects in the end have proved largely transitory. Constant risk premia, to cite one prominent candidate, would therefore have to be ruled out as an explanation for this phenomenon.

1. Theoretical considerations and previous studies

According to the purchasing power parity (PPP) theorem the logarithm of the nominal exchange rate $\hat{s}$ the foreign-currency price of a unit of domestic currency, will equal the difference in the logarithms of the foreign and domestic price levels, $p^{\mathrm{F}} - p$:

$$s_t = p_t^{\mathrm{F}} - p_t, \tag{1}$$

where the superscript F denotes the foreign country and the subscript t, the time period.

Transformed into growth rates, this becomes

$$\hat{s}_t = \hat{p}_t^{\mathrm{F}} - \hat{p}_t, \tag{2}$$

where a carat over a variable represents a time derivative.

Purchasing power parity has been rationalized both as an offshoot of the law of one price, and as a condition of equilibrium in a variety of macroeconomic models. The latter range from simple open-economy versions of the quantity theory of money to Lucas's (1982) two-country, cash-in-advance model. These models view PPP as an equilibrium position that follows from the homogeneity postulate.[3]

The second important relationship, the Fisher equation, posits a one-to-one relation between the nominal interest rate and the anticipated rate of inflation over the life of the particular bond:

$$R_t = \rho_t + \hat{p}_t^*, \tag{3}$$

where R_t is the nominal interest rate, ρ_t is the ex ante real interest rate and $\hat{p}_t^*$ is the anticipated rate of inflation. The theoretical rationale for this relationship between nominal interest rates and anticipated rates of inflation stems from the neutrality proposition. If, for example, money supply growth increases causing an increase in inflation, lenders will demand and borrowers will be willing to pay a higher nominal interest rate once the higher inflation comes to be anticipated. For money to be neutral in this instance, for ρ to be unaffected, the increase in the nominal interest rate will have to match exactly the increase in inflation.

The third key relation, uncovered interest parity (UIP) is in fact simply the international analogue of (3). The difference is that the factor that is viewed in the first instance as relevant is the currency in which the bonds are denominated rather than variations in inflation over time. According to UIP

$$\left(R_t^{\mathrm{F}} - R_t\right) = \hat{s}_t^*, \tag{4}$$

where $\hat{s}_t^*$ is the anticipated change in the nominal exchange rate.

To see this link between UIP and the Fisher equation, consider a two-country version of the latter:

$$\left(R_t^{\mathrm{F}} - R_t\right) = \left(\rho_t^{\mathrm{F}} - \rho_t\right) + \left(\hat{p}_t^{*\mathrm{F}} - \hat{p}_t^*\right). \tag{5}$$

Then, in order to let the exchange rate enter explicitly, subtract the anticipated rate of change of the nominal exchange rate $\hat{s}_t^*$ from both sides to obtain

$$\left(R_t^{\mathrm{F}} - R_t\right) - \hat{s}_t^* = \left(\rho_t^{\mathrm{F}} - \rho_t\right) - \left(\hat{s}_t^* - \left[\hat{p}_t^{*\mathrm{F}} - \hat{p}_t^*\right]\right). \tag{6}$$

Equation (4) therefore follows directly from (3) given the assumptions of equality of ex ante real interest rates and of anticipated purchasing power parity. If real rates are equal, any difference in nominal interest rates in the two countries must be due to a difference in the respective anticipated rates of inflation. If PPP holds, however, that difference will be reflected exactly in the anticipated change in the nominal exchange rate. Both right-hand side terms in (6) will be zero, in which case deviations from UIP, the left-hand side, will also be zero.

An alternative way to view uncovered interest rate parity, which we mention here since it underlies much of the empirical work on UIP, is in terms of covered interest rate parity (CIP) and the hypothesis of unbiased forward exchange rate expectations. This becomes clear from the following decomposition of UIP:

$$\left(R_t^{\mathrm{F}} - R_t\right) - \hat{s}_t^* = \left(\left[R_t^{\mathrm{F}} - R_t\right] - fd_t\right) + \left(fd_t - \hat{s}_t^*\right), \tag{7}$$

where the first term in parentheses on the right hand side of (5) is the deviation from CIP, and the second is the bias in the prediction of the spot exchange rate change implicit in the forward premium fd. The rationale here is straightforward (see Isard, 1992). In the absence of capital controls or other such impediments, riskless arbitrage in financial markets will lead to covered interest parity and the first term on the right in (7) will be zero. If market participants are risk neutral and take uncovered positions when the forward rate differs from the expected future spot rate, then the second term too will be zero. Uncovered interest parity therefore will hold.

For equities, there is a direct parallel to the Fisher equation for bonds and to UIP. As in the case of bonds, we can write the nominal return on equities as

$$R_t^e = \rho_t^e + \hat{p}_t^*, \tag{8}$$

where R^e is the anticipated nominal return the ρ^e is the anticipated or ex ante real return. An analogous relation will hold between actual nominal equity returns and actual inflation since firms' nominal earnings can be expected to rise in line with their product prices.

If we ignore considerations of portfolio risk, we can use the same logic as we did in deriving the UIP relation for bonds, to derive the equity-market analogue:

$$\left(R_t^e - R_t^{e\mathrm{F}}\right) = \hat{s}_t^*, \tag{9}$$

Here the theoretical rationale is similar to that for UIP and can be couched in terms of an equation directly analogous to (6).

In the presence of portfolio risk, the right-hand and left-hand sides of (9) will not necessarily be equal. If one country's portfolio is riskier than the other's, the anticipated nominal return differential will differ from the anticipated rate of change of the exchange rate by the diffrential in the risk premia. In that case (9) may, however, still prove to be a fairly good empirical approximation provided that the variability of inflation rates is large relative to the variability in risk premia over the sample.

Since the five relationships described by Eqs. (2), (3), (4), (8) and (9) are equilibrium conditions, they are likely to be much more closely approximated over the long run than over the short run. In the short run, a variety of factors in principle can create disturbances. Consider first the effects of a monetary shock—a sudden and unanticipated increase in domestic monetary growth, for example. In the short run during the transition to the new equilibrium, domestic bond and equity returns, both nominal and real, first will fall and then will rise. These are the liquidity and income effects posited by theory. At the same time, the nominal exchange rate will depreciate. Initially this depreciation will be by more than would be warranted by the now higher long-run domestic inflation rate; subsequently, but still as part of the transition process, it will for a time be by less. This is the exchange-rate overshooting common to most monetary models. Until the new long-run equilibria are reached, therefore, the two Fisher relationships will appear weak and purchasing power parity and the uncovered parity relationships will appear to be violated.

Alternatively consider the effect of a real shock to the domestic economy caused, say, by a wave of innovations. The immediate effect of these innovations will be to increase the return to investment in physical capital, which via arbitrage will give rise to similar increases in the returns (nominal and real) on both bonds and equities. The exchange rate meanwhile will appreciate, and in response to the higher interest rates, desired real cash balances will undergo a one-time decrease and the price level a one-time increase. As investment proceeds and the actual capital stock starts to approach the now higher desired stock, returns on physical capital will start to decline and with them the returns on bonds and equities. The nominal exchange rate will depreciate, reflecting both the decline in capital inflows and the rise in the price level. In principle the movements in real bond and equity returns and the real exchange rate could all cancel out, making the new long-run equilibria identical to the old. Here, however, theory is a somewhat uncertain guide, and even if such returns to equilibrium occur, there is reason to suspect that the adjustment process will be a lengthy one, in which case deviations from all five relations will be highly persistent.

Finally consider the problems posed by a change in monetary regime, for example a shift to less inflationary policy of the sort that occurred in the United States in the early 1980s. If agents only gradually learn that the new regime is in place, the rate of inflation that they anticipate will systematically exceed and only slowly approach the actual rate, with consequent effects on all five relationships. Until the learning process has been completed, nominal bond and equity returns will appear unduly high relative to the actual rate of inflation and nominal exchange rates will continue to appreciate with no apparent link to the inflation differential.

1.1. Previous studies

During the past two and a half decades of floating exchange rates, purchasing power parity has been the subject of a substantial number of empirical studies. As little as five years ago, the majority of researchers who were familiar with this literature probably would have agreed with Dornbusch's (1988, p. 1081) conclusion that purchasing power parity had "failed altogether" in the 1970s and that in general it lacked empirical support. Since then, however, the consensus has shifted. An increasing number of studies based on long-term historical data have pointed to mean reversion of real exchange rates, and hence eventual convergence of nominal exchange rates and relative price levels.[4] Evidence derived from data for the float alone, however, generally has been less favorable to the PPP hypothesis. Although that also has begun to change, many researchers continue to regard real-exchange-rate behavior during this period as different from historical experience, perhaps as a result of more severe real shocks during the floating-rate years.[5]

The problem that has arisen with regard to UIP can best be seen in terms of the decomposition of UIP into the CIP and forward-versus-spot market components shown in Eq. (8). Recent empirical studies generally have supported CIP for major industrial countries over the past decade to decade and a half (see Mussa and Goldstein, 1993). Other studies, however, have almost universally pointed to a bias in the implicit predictions of the growth rate of the spot (nominal) exchange rate implicit in forward premia.[6] A considerable literature has developed trying to explain this phenomenon, with risk premia, regime switching of the type that we described above, and irrationality of traders all being offered as explanations. Our purpose here is not to try to discriminate among these explanations, but simply to see how well UIP performs over the long run.[7]

Previous studies of the Fisher equation also have produced mixed results. There is clearly a substantial positive correlation between nominal interest rates and measures of anticipated inflation over the past several decades, but researchers have differed in their conclusions with regard to whether the effect has been complete, over which periods it as held, and even with regard to what in theory constitutes a complete Fisher effect given the existence of income taxes.[8] Crowder and Hoffman (1996), Mishkin (1993), and Evans and Lewis (1995) review the recent literature, and report results based on post-WWII U.S. data that are particularly relevant to this paper. Mishkin (1993) using bi-variate cointegration tests, finds a long-run Fisher effect, but no short-run effect. Crowder and Hoffman using more powerful multivariate analogues of such tests add to this evidence. Evans and Lewis (1995), using a Markov switching model to generate a series for the anticipated rate of inflation, provide evidence of a (full) long-run effect. They ascribe the failure of other researchers to do so to specification errors in their estimates of the anticipated rate of inflation resulting from failure to account for the effects of changes in the monetary regime on expectations.

While real equity returns should in principle be invariant to inflation, a considerable number of studies (e.g., Fama and Schwert, 1977; Guletkin, 1983; and Kaul, 1987) have presented evidence that they have not been so in actual fact. Indeed, a sizable literature has developed on this subject, the object of which has been to test various explanations for this apparent failure.[9] The only recent published study presenting evidence to the contrary with which we are acquainted is Boudokh and Richardson (1993). Using historical time series for the U.S. and the U.K. they report results consistent with a long-run (though not a short-run) positive relationship between equity returns and inflation. Their conclusions are in fact in line with those reached much earlier by Cagan (1974) in one of the few other studies that has provided at least some support the hypothesis of invariance of real equity returns to inflation.[10]

Studies of the links among equity markets have typically focused on dynamic relations at much higher frequencies than the data that we examine (e.g., Longin and Solnik, 1995 and the references cited therein). These studies reveal a positive but far from perfect correlation among returns internationally with some increase in correlation from the 1960s on. Unlike the studies of UIP, the literature dealing with equity market links has paid little attention to the reasons for their apparent weakness. It is simply taken as a stylized fact. Nor has any attention been paid to the long-run properties of the relation.

Two conclusions therefore emerge from these studies. The first in the main is negative, that all five financial relations have not performed very well over shorter time horizons during the past several decades. The second, more positive conclusion is that the performance of at least some of these relations over longer horizons, as one might expect, has been a good deal better. Studies that have reported such results, however, generally have used very long historical time series. One obvious potential explanation for this better performance in long spans of data is that deviations from equilibrium are so long-lived that short spans of data do not contain sufficient information for researchers to detect equilibrating behavior.[11] Since we wish to study recent experience, we use panel data for a relatively large group of countries, rather than long time series for one or two countries to try to gain the necessary additional degrees of freedom.

2. Data and methods

The underlying data are annual series for the United States and 22 other OECD countries over the period 1973 to 1994. Exchange rates are denominated in U.S. dollars; price levels are measured by the consumer price index or similar cost-of-living index; interest rates are short-term domestic money market rates. The equity-price indexes used in computing nominal equity returns are whatever indexes are reported by the International Monetary Fund in their International Financial Statistics, generally, though not always, indexes of industrial share prices.[12] Since our principal interest is in the longer term equilibrium properties of the five relationships, we use filtered versions of these data—long-period arithmetic averages of log differences (or in the case of interest rates, levels) of the yearly data—in most of the empirical work reported below.[13] Throughout the actual rates of inflation and of exchange-rate change serve as proxies for the anticipated rate. Given our use of long averages of yearly data in most of the empirical work, the actual rates may, in fact, provide a fairly useful first approximations to the anticipated rates, since under rational expectations the mean of the expectational errors will approach zero as the period lengthens.

In the analysis that follows, we first examine how well the five relations hold over the sample as a whole using full-period averages as our units of observation. We then go on to examine shorter run behavior, comparing results from cross sections of yearly data, of three-year averaged data and of seven-year averaged data. An alternative to this approach would be to apply time-series methods of one sort or another. One obvious possibility would be to conduct univariate and multivariate tests for mean reversion and cointegration and to estimate the corresponding error-correction models. Another would be to estimate the permanent and transitory components of these series as in Evans and Lothian (1993). In principle, such approaches would seem to make better use of the data since the year-to-year variation might be better exploited. In practice, however, much of this apparent advantage is liable to prove illusory. A major message that has come out of the recent literature on purchasing power parity is the importance of data span in comparison to frequency of observation. Distinguishing between unit root behavior and the near unit root behavior characteristic of slow reversions to equilibrium has proven almost impossible using conventional tests and time series covering only several decades of experience; very long time series or panel data for a substantial number of countries are required. This should not be surprising. If the deviations from long-term equilibrium are persistent, the number of episodes in which such deviations occur rather than year-by-year or quarter-to-to-quarter behavior within those episodes will contain the more meaningful information about equilibrium behavior.

Our use of long-term averages is one way of extracting this information. The principal advantage of this approach is its simplicity.[14] A tolerably good idea of the degree of correspondence of all five relationships to theory almost literally can be had at a glance. A further advantage is that the cross-sectional information in the data is not lost. The results, moreover, are easy to replicate. We therefore view this approach as a useful first step, a complement to, rather than substitute for, more econometrically elaborate approaches.

3. Results

Figures 1 through 5 and Tables 1, 2 and 3 summarize the basic results of the empirical analysis. Figures 1, 2, and 3 plot the PPP relation, the Fisher equation, and the UIP relation, respectively. Figures 4 and 5 plot the two equity relations.

Table 1. Regression results for PPP, the Fisher equation, and UIP ($y_i = \alpha + \beta x_i + \epsilon_i$).

Variables					
y	x	Nobs	α SE	β SE	R^2 SEE
$\hat{s}$	$\hat{p}^{\mathrm{F}} - \hat{p}$	22	−0.568	1.068	0.989
			0.236	0.025	0.983
$\hat{p}^{\mathrm{F}} - \hat{p}$	$\hat{s}$	22	0.574	0.926	0.989
			0.214	0.022	0.916
R^{b}	$\hat{p}$	23	3.080	0.965	0.973
			0.518	0.035	1.359
$\hat{p}$	R^{b}	23	−2.843	1.009	0.973
			0.543	0.037	1.390
$\hat{s}$	$R^{\mathrm{bF}} - R^{\mathrm{b}}$	22	−1.247	1.087	0.976
			0.361	0.038	1.450
$R^{\mathrm{bF}} - R^{\mathrm{b}}$	$\hat{s}$	22	1.237	0.898	0.976
			0.308	0.032	1.318

Source: See text.
Notes: $\hat{s}$ is the change in the log of the nominal US dollar exchange rate, $\hat{p}^{\mathrm{F}}$ and $\hat{p}$ are changes in the logs of the foreign and the US price levels, R^{bF} and R^{b} are the foreign and US short-term interest rates, SE is the standard error of the coefficient, SEE is the standard error of estimate, and R^2 is the unadjusted coefficient of determination. All data are in the form of period averages.

In all instances, the basic units of observation in the charts are averages for the full sample period. Tables 1 and 2 contain regression results.

In the first three charts, the picture is virtually the same. In each, the individual points appear to be scattered fairly closely about a forty-five degree line drawn through the origin. There thus appears to be a close to one-to-one relationship in all three cases. The corresponding regressions reported in Table 1 tell a similar story to those of the charts. To allow for measurement error, we have run these regressions two ways: first in a form that corresponds directly to the theoretical relationship described in Eqs. (2), (3) and (4), and then after reversing the dependent and independent variables.[15] For all three relations the slope coefficients (or in the case of the three reverse regressions their reciprocals) are close to unity as theory would suggest. For the Fisher equation they are almost identically so. It is worth noting in addition that these results are not simply a result of extreme observations dominating the relationships statistically. When we omitted the two high inflation countries, Iceland and Turkey, from the cross sections the results for the Fisher equation remained unchanged and for PPP and UIP actually improved somewhat. For neither variant of either the PPP or the UIP relation could we reject the null hypothesis of a unit slope coefficient when these two countries were omitted. For the full cross-section of countries,

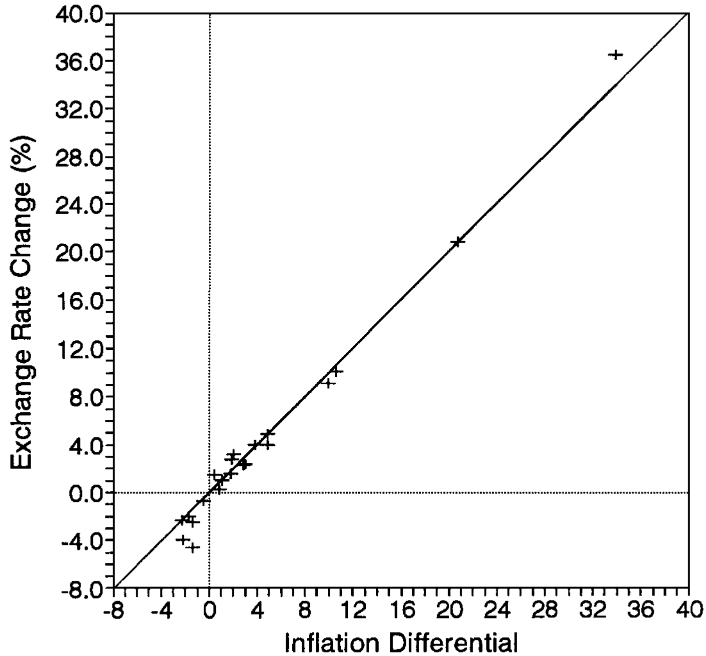

Figure 1. Purchasing power parity: 22 countries, 1974–1994.

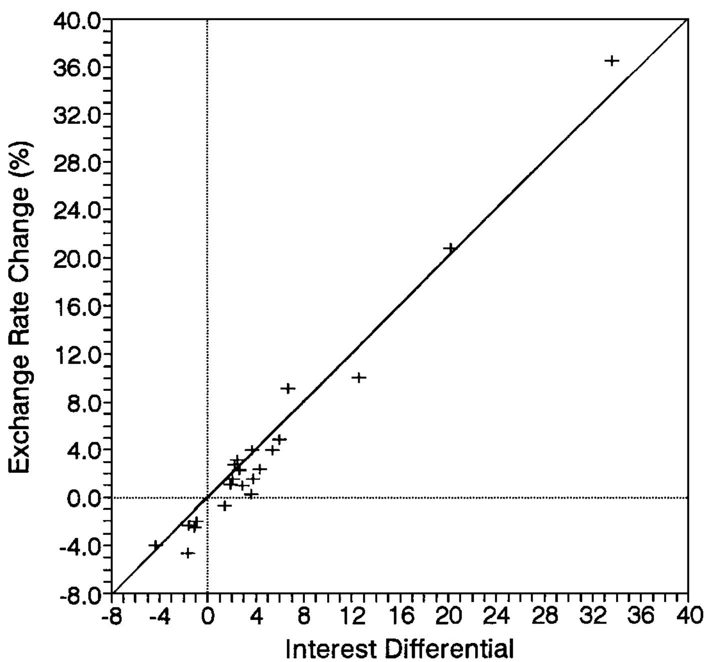

Figure 2. Uncovered interest parity: 22 countries, 1974–1994.

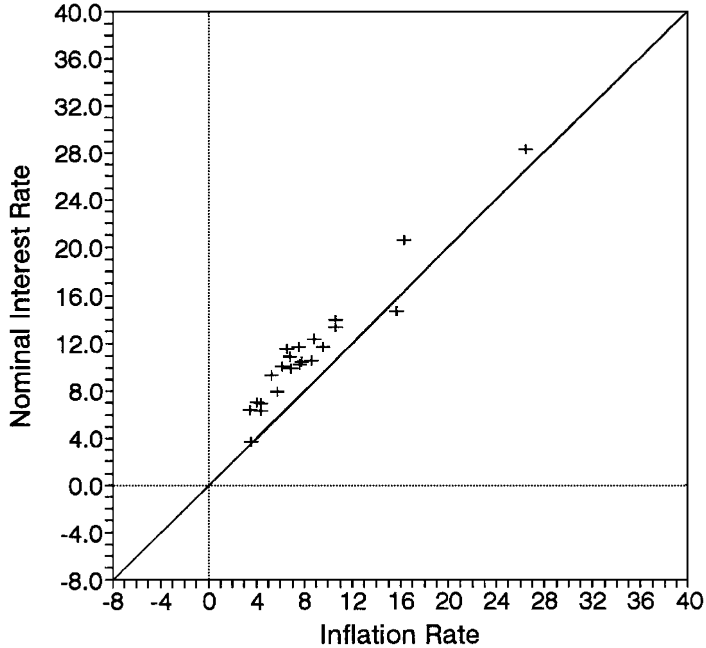

Figure 3. Fisher equation: 23 countries, 1974–1994.

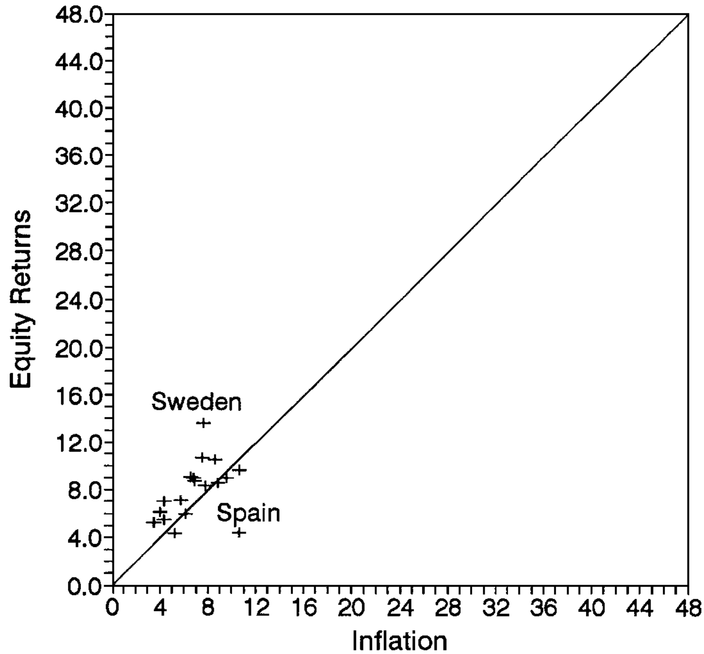

Figure 4. Equity returns and inflation: 18 countries, 1974–1994.

Table 2. Regression results for equity returns ($y_i = \alpha + \beta x_i + \epsilon_i$).

Variables					
y	x	Nobs	α SE	β SE	R^2 SEE
All countries					
R^e	$\hat{p}$	18	4.235	0.518	0.229
			1.692	0.238	2.273
$\hat{p}$	R^e	18	3.337	0.442	0.229
			1.645	0.203	2.100
$\hat{s}$	$R^{eF} - R^e$	17	0.335	0.573	0.259
			0.650	0.250	2.585
$R^{eF} - R^e$	$\hat{s}$	17	0.314	0.452	0.259
			0.574	0.197	2.297
Omitting Spain and Sweden					
R^e	$\hat{p}$	16	2.858	0.729	0.654
			0.966	0.142	1.225
$\hat{p}$	R^e	16	−0.325	0.896	0.654
			1.363	0.174	1.358
$\hat{s}$	$R^{eF} - R^e$	15	−0.189	0.949	0.475
			0.548	0.267	2.111
$R^{eF} - R^e$	$\hat{s}$	15	0.386	0.500	0.475
			0.386	0.141	1.532

Note: R^{eF} and R^e are changes in the logarithms of the equity price indexes. All other variables are as previously defined.

in contrast, this was not the case. For both PPP and UIP we were always able to do so; the same was true for the hypothesis of a zero intercept.

Viewed solely from the standpoint of these formal tests, therefore, the data appear inconsistent with both PPP and UIP. Viewed in the broader context of overall correspondence with the implications theory, the two perform tolerably well. As theory suggests, countries with high inflation rates see their exchange rates depreciate. Correspondingly the rate at which the depreciation occurs increases almost one for one with increases in the inflation differential. An analogous situation prevails, moreover, for countries with high nominal interest rates.

The equity-price relations are less well-behaved in general, but nonetheless still broadly in accord with theoretical predictions. This is evident in both the scatter plots shown in figures 4 and 5 and in the regressions reported in Table 2. For the 18 countries for which we have equity price data we see a positive relation between our proxy for equity returns (the rate of growth of nominal equity prices) and inflation, but the estimated coefficients are quite far removed from unity. There is also a deterioration in the goodness of fit of these regressions relative to those discussed above—standard errors that are anywhere from

Table 3. Results of additional equity regressions ($y = \alpha + \beta x$).

Variables: y	Variables: x	Nobs	α SE	β SE	R^2 SEE
		IFS and Cagan data: 1939–1994			
All countries					
R^e	$\hat{p}$	17	1.815	0.964	0.463
			1.624	0.268	1.731
$\hat{p}$	R^e	17	2.271	0.480	0.463
			1.039	0.134	1.222
Omitting Spain					
R^e	$\hat{p}$	16	0.496	1.243	0.729
			1.199	0.203	1.228
$\hat{p}$	R^e	16	1.261	0.586	0.729
			0.757	0.096	0.844
		Morgan Stanley data: 1974–1994			
Omitting Spain					
R^e	$\hat{p}$	15	6.837	0.738	0.306
			1.980	0.268	2.345
$\hat{p}$	R^e	15	1.412	0.414	0.306
			2.016	0.173	1.757

Notes: See text for data descriptions and Tables 1 and 2 for definitions of symbols.

51% to 68% higher in the equity regressions than in the bond-market Fisher equations and a coefficient of determination that is only .229 versus a figure of .973 for the Fisher equations. Roughly the same things are true for the equity version of UIP.

Some of the difference vis-à-vis the results for UIP and the Fisher equation, however, seems to be due to the existence of two outlying observations—Spain and Sweden. Omitting these countries from the sample resulted in a sizable increase in the relevant slope coefficients and a noticeably better fit for the regressions. We can see these results in the bottom half of Table 2.

What also may be unduly influencing the results is the choice of sample period. In his earlier investigation of the relationship between equity returns and inflation across countries, Cagan (1974) used average rates of change of equity prices from the late 1930s (the starting dates differ slightly from one country to the next) to 1969 as his units of observation.[16] He found a positive relation between the two but concluded that there were extremely long lags in the adjustment of equity prices to inflation. To allow for the possibility of longer adjustment, we extended our data series back to 1969 and linked the resultant figures to Cagan's.

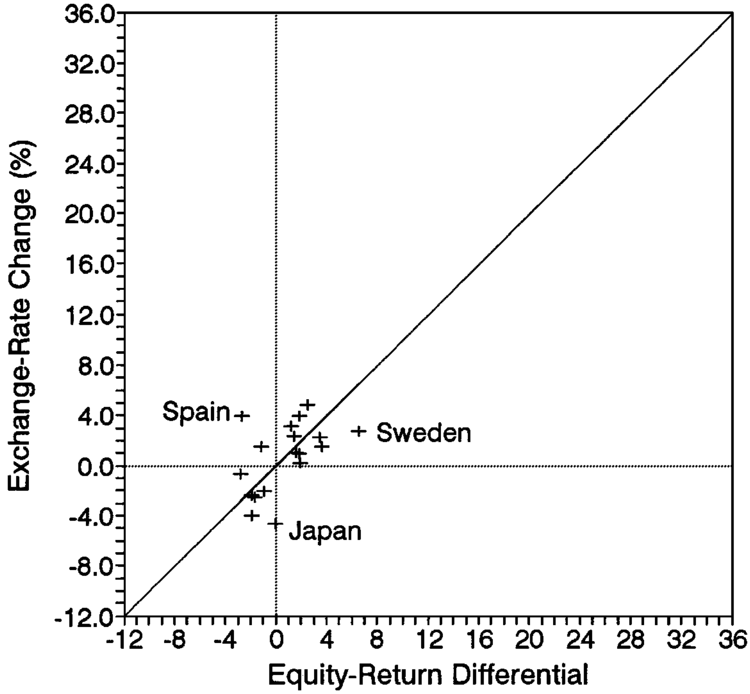

Figure 5. Exchange-rate change and equity-return differential, 17 countries, 1974–1994.

Figure 6 shows the plot of R^e on $\hat{p}$ for the extended sample period running from the late 1930s through 1994. Table 3 contains the corresponding regression results. Since Spain again appeared to be an outlier, we ran the regressions with and without Spain. All show an improvement relative to the results reported in the upper half of Table 2. Furthermore, with the one notable exception of Spain all of the individual observations are positive.

An additional problem may be the omission of dividends from the IFS data. A dividend-inclusive series computed by Morgan Stanley Capital International that a number of other researchers have used in studies of the international equity market (e.g., Harvey, 1991) is available for our sample period for 16 of the 19 countries for which we have IFS data.[17] Accordingly, we re-ran both sets of equity return regressions with these data. For the equity-market uncovered parity relation linking exchange rate changes and return differentials, the results are virtually identical to those obtained with the IFS data. We therefore omit these findings from the paper. The lower portion of Table 3 reports regressions results for the equity-market Fisher relation. Figure 7 provides the corresponding scatter plot of the period-average equity returns relative to inflation. These results for the most part are similar to those obtained using the IFS data. The one noticeable difference—and it would be surprising if this were not the case—is the higher average rate of return in each instance now that dividends have

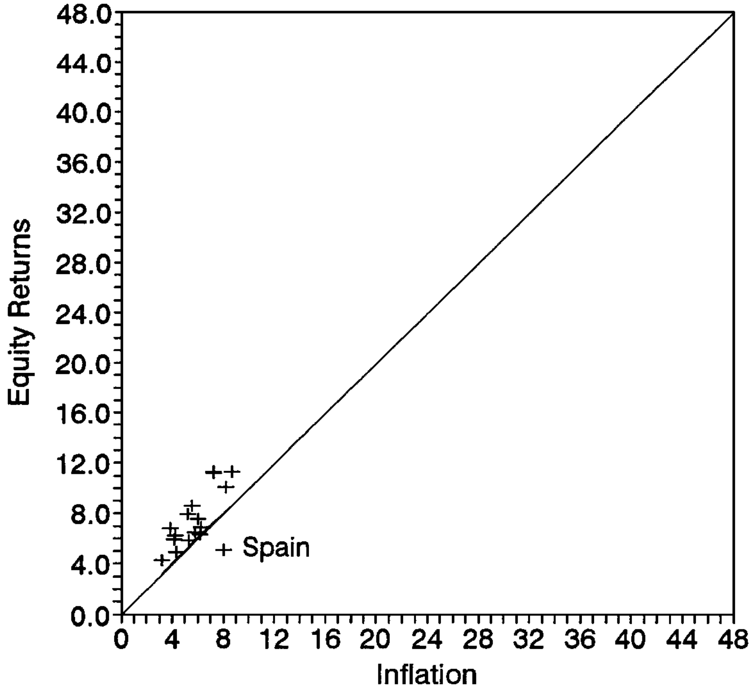

Figure 6. Equity returns and inflation: 17 countries, 1939–1994.

been included. Within countries nominal returns more than out-pace inflation in all but one instance, and on average by a much greater amount than with the IFS series. The exception again is Spain, for which the difference between the two remains negative, although very much smaller in absolute value than previously. Across countries, there is again a positive correlation between average returns and inflation, but this only becomes strong if Spain again is treated as an outlier. We can see all of this clearly in figure 7.

A final feature of the long-term data that deserves comment is the relation between the average equity returns shown here in figure 7 and average interest rates for this same subset of countries plotted for the full sample of countries in figure 2. The mean differential between the two is 1.3 percentage points, which is suggestive of an equity premium of that magnitude. Interestingly, however, we find a positive average differential in only nine of the sixteen countries viewed individually. In the remainder, the average interest rate exceeds the average equity return by 1.6 percentage points. These findings raise the intriguing question of whether the "equity premium puzzle"—the close to seven percentage point difference in equity returns versus treasury bill returns found in U.S. data that has attracted so much attention—may be a statistical anomaly.

To investigate the short-run adjustment processes, we ran a series of cross-country regressions using annual data, three-year nonoverlapping averages,

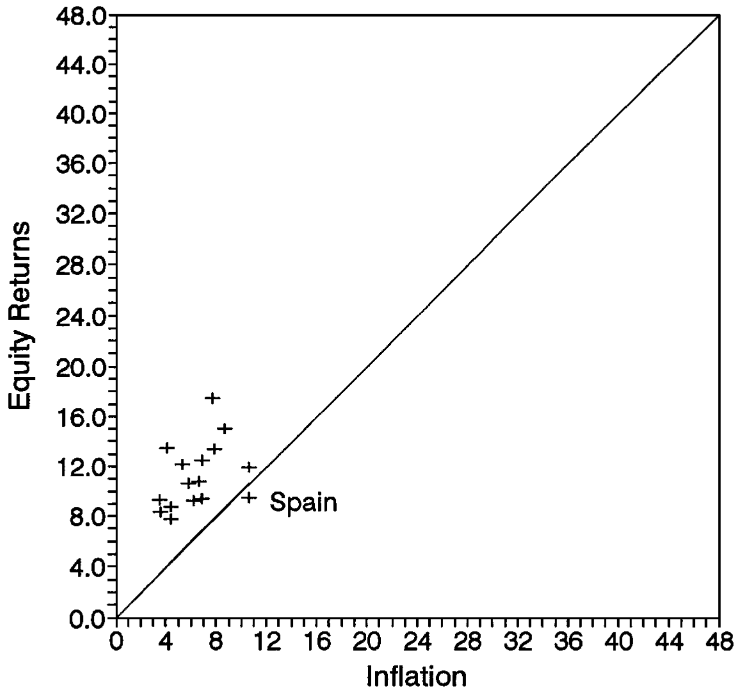

Figure 7. Equity returns and inflation: Morgan Stanley data, 16 countries, 1974–1994.

and seven-year nonoverlapping averages. These results are summarized in Table 4. As one would expect, all five relations perform better over longer horizons than over shorter. Standard errors are lower, the coefficients are more stable and in most instances—the UIP equation is a partial exception—the means of the estimated slope coefficients are closer to unity. In general, the regressions using the seven-year averages produce results quite similar to those reported in the previous tables for the full-period averages. There are, however, differences across relations. In the cases of PPP, UIP and the Fisher equation, the adjustment appears to be somewhat quicker, and as already noted more nearly complete than it does for the two equity relations. For the latter, in contrast, the results are only reasonably consistent with theory at the seven-year horizon, and in the case of the UIP-type equity relation still quite different from the full-period results in Table 2.

Hence, for whatever the reason, the deviations from the equilibrium relation posited by theory are rather long-lived in all cases, especially so for the two equity relations. In the case of equity returns and inflation, in particular, this may be due to taxes and other factors that impede firms' adjustment to inflation as Feldstein (1980) has claimed. It may also be heightened by differences in the risk characteristics of the portfolios making up the various countries' indexes. In any event, these long lags are a stylized fact of considerable interest.

Table 4. Summary of regression results with annual, 3-year average and 5-year average data.

		α	β	R^2	SEE
			PPP		
Yearly	Mean	−0.602	1.050	0.736	5.561
	Range	41.151	1.193	0.512	5.628
3-Year	Mean	−0.479	1.047	0.892	3.389
	Range	22.929	0.441	0.127	2.491
7-Year	Mean	−0.507	1.044	0.967	1.727
	Range	3.011	0.100	0.028	0.485
			UIP		
Yearly	Mean	−0.467	1.003	0.610	6.931
	Range	44.441	1.437	0.928	17.498
3-Year	Mean	−0.452	1.042	0.793	4.453
	Range	26.799	0.919	0.517	6.250
7-Year	Mean	−0.092	0.857	0.772	3.700
	Range	5.405	0.146	0.549	4.778
			Fisher equation		
Yearly	Mean	4.838	0.879	0.719	3.591
	Range	9.004	1.884	0.828	5.327
3-Year	Mean	4.313	0.921	0.806	3.003
	Range	3.748	0.964	0.520	3.764
7-Year	Mean	3.631	0.978	0.796	3.376
	Range	1.998	0.584	0.458	3.104
			Equity returns vs. inflation		
Yearly	Mean	7.036	−0.210	0.063	14.410
	Range	55.526	5.790	0.263	10.789
3-Year	Mean	8.460	−0.427	0.099	8.224
	Range	23.937	3.326	0.254	6.967
7-Year	Mean	3.038	0.649	0.199	4.276
	Range	15.362	0.901	0.318	1.236
			Exchange-rate growth vs. equity return differential		
Yearly	Mean	0.180	0.039	0.067	6.346
	Range	35.865	0.455	0.296	9.713
3-Year	Mean	−0.236	0.035	0.068	4.349
	Range	22.142	0.492	0.161	4.139
7-Year	Mean	0.243	0.313	0.201	2.863
	Range	2.284	0.516	0.368	2.111

Notes: The regressions summarized above are cross-county regressions run on annual data, nonoverlapping 3-year averages and nonoverlapping 7-year averages of the annual data. Both Spain and Sweden were omitted from the two sets of equity-return regressions.

4. Conclusions

The results reported in this paper, to our minds, go a considerable way in helping to rehabilitate the traditional relations of international finance theory. Deviations from UIP, PPP and from the full Fisher effect have been attributed to permanent shocks. Our comparisons do not allow us to separate the permanent and transitory components of the relevant series. Nevertheless, they suggest that for many important practical purposes, permanent shocks to these relations can be treated as relatively unimportant. The nominal exchange rate behavior observed in these data does in fact correspond to the common sense notions derived from theory. High-inflation countries see their exchange rates depreciate relative to low inflation countries over the longer term, with differences in the extent of that depreciation varying among countries roughly in line with inflation differentials. The same thing is true for countries with high nominal interest rates. The Fisher effect, therefore, does approximately hold over the longer term in the bond market.

An analogous situation prevails in the equity market. Within countries, nominal equity returns respond more or less fully over long periods to variations in inflation in virtually every instance; across countries the two are positively correlated. Cross-country differentials in equity returns, moreover, bear a positive and fairly strong relation to changes in nominal exchange rates.

In the case of purchasing power parity, and to some extent also the bond-market Fisher effect, these findings are hardly a complete surprise. They simply provide bits of added weight to existing bodies of empirical evidence—voluminous in the case of PPP, smaller but, nevertheless, influential in the case of the Fisher effect. For uncovered interest parity and the equity-market Fisher effect, in contrast, positive results of any sort have been very few and far between. The proportionate contributions of our findings in these two instances are therefore much greater.

In the case of UIP they suggest in line with Baillie and Bollerslev's (1997) recent conjectures that its poor performance in earlier studies may have been simply an artifact of one specific sub-period rather than a characteristic of the current period of floating exchange rates, or of floating-rates in general. In the case of equity returns, they corroborate Cagan's (1974) much earlier conclusions that equity markets do in fact adjust to inflation but that the adjustment period is exceedingly long, lasting a decade or more rather than several months, quarters or even years. They also dispel some of the doubts concerning the applicability to recent experience of the findings reported by Boudokh and Richardson (1993) in their historical study of the equity returns and inflation.

Having described the portion of the glass that is full, we should say something about the portion that is empty. Here the principal issue is short-run behavior. Disturbances to these relations, even if largely transitory, clearly have been very persistent in their effects. The adjustment process appears to take a good deal of time in all instances, much longer than usually envisioned in modern finance theory. For many business and individual portfolio decisions, as well as for much government policy, these relations therefore have at best provided only rather noisy signals. Why this is so is, what in each instance is responsible for this behavior, is an—if not *the*—important question to be answered.

Notes

1. We review this literature in this paper.
2. Earlier studies that have used a similar methodology include Lucas (1980), Lothian (1985), and Duck (1993).
3. In these basic models, PPP holds continuously. In more complex models, a variety of factors are admitted to allow for departures from PPP over the short run and, in some instances, over the long run also.
4. See for example Diebold, Husted and Rush (1991), Lothian and Taylor (1996), and the studies cited in the latter paper.
5. Studies that have produced results more favorable to PPP over this period almost exclusively use panel data. These include Frankel and Rose (1996), Jorion and Sweeney (1996), Lothian (1997) and Oh (1996). See Evans and Lothian (1993) and Mark (1995) for additional corroborative results obtained using different econometric procedures.
6. See Frankel (1992) for a summary of these issues and Engel (1996) for an extensive survey on the question of the forward discount bias.
7. As noted earlier, improved performance of UIP over the longer run would not be devoid of implications with regard to the causes of the short-term deviations from UIP. Such a finding would be inconsistent with the existence of constant risk premia, for example.
8. See Darby (1975) and Gandolfi (1982) for differing conclusions with regard to tax effects.
9. These studies include Feldstein (1980), Fama (1981), and Geske and Roll (1983).
10. As Kaul (1987) pointed out, adjustment still appeared to be incomplete in these data, since for many of Cagan's countries viewed individually the average rate of inflation exceeded the average rate of change of nominal equity prices.
11. For a discussion of this point in the specific context of the PPP relationship see Lothian and Taylor (1996). More general discussions in the time-series econometric literature include Shiller and Perron (1985) and Hakkio and Rush (1991).
12. The exchange rates are yearly averages as listed in either line rf or line rh of the International Financial Statistics; the figures for the cost-of-living indexes are yearly averages as listed in line 64, the short-term interest rates are the yearly-average money-market rates listed in line 61 and the equity price indexes the yearly average series listed in line 62. Because the IMF equity data do not include dividends, we use measures of the average rates of growth of equity prices, as a proxy for equity returns.
13. In some initial experiments (not reported here since the results in most instances were very similar) we used slopes of log-linear trends fitted to the annual series as our units of observation.
14. A potential disadvantage is that the choice of the period over which to average is ad hoc. As it happens, however, this does not appear to be a problem in most instances since, as we show below, the results do not vary greatly when long sub-period averages as opposed to full-period averages are used in the analysis. The one notable exception, which we discuss at some length, is the equity-market Fisher equation.
15. Consider the PPP relation. If $\hat{p}^{\mathrm{F}} - \hat{p}$ alone were measured with error, the slope coefficient in the regression of $\hat{p}^{\mathrm{F}} - \hat{p}$ on $\hat{s}$, call it β_s, would be an unbiased and consistent estimate of the true coefficient. Alternatively (and less realistically) if only $\hat{s}$ were measured with error, then, $1/\beta_p$, the reciprocal of the slope coefficient in the regression of $\hat{s}$ on $\hat{p}^{\mathrm{F}} - \hat{p}$, would provide an unbiased and consistent estimate of the true coefficient. If both variables were measured with

error, then these two estimates, β_s and $1/\beta_p$, would provide lower and upper bounds on the true coefficient.

16. The starting date used by Cagan for most counties is 1939, but for several countries for which data for 1939 are unavailable it is one or two years earlier.
17. We are indebted to Campbell Harvey for making these data available to us.

References

Baillie, Richard T. and Tim Bollerslev (1997) "The Forward Premium Anomaly Is not as Bad as You Think." Unpublished Working Paper, Michigan State University.

Boudokh, Jacob and Matthew Richardson (1993) "Stock Returns and Inflation: A Long Horizon Perspective." *American Economic Review* 83, 1346–1355.

Cagan, Phillip (1974) "Common Stock Values and Inflation: The Historical Record of Many Countries." *Annual Report Supplement, National Bureau of Economic Research*. New York, NY: National Bureau of Economic Research.

Crowder, William, J. and Dennis L. Hoffman (1996) "The Long-Horizon Relationship between Nominal Interest Rates and Inflation: The Fisher Effect Revisited." *Journal of Money, Credit and Banking* 28, 102–118.

Darby, Michael R. (1975) "The Financial and Tax Effects of Monetary Policy on Interest Rates." *Economic Inquiry* 13, 266–276.

Diebold, Francis X., Stephen Husted and Mark Rush (1991) "Real Exchange Rates under the Gold Standard." *Journal of Political Economy* 99, 1252–1271.

Dornbusch, Rudiger (1980) "Purchasing Power Parity." In John Eatwell, Murray Milgate and Peter Newman (eds.), *The New Palgrave: A Dictionary of Economics*. New York: Stockton, pp. 1075–1085.

Duck, Nigel W. (1993) "Some International Evidence on the Quantity Theory of Money." *Journal of Money, Credit and Banking* 25, 1–12.

Engel, Charles (1996) "The Forward Discount Anomaly and the Risk Premium: A Survey of Recent Evidence. *Journal of Empirical Finance* 3, 123–192.

Evans, Martin D.D. and James R. Lothian (1993) "The Response of Exchange Rates to Permanent and Transitory Shocks under Floating Exchange Rates." *Journal of International Money and Finance* 11, 563–586.

Evans, Martin D.D. and Karen Lewis (1995) "Do Expected Shifts in Inflation Affect Estimates of the Long-Run Fisher Effect." *Journal of Finance* 50, 225–253.

Fama, Eugene (1981) "Stock Returns, Real Activity, Inflation and Money." *American Economic Review* 71, 545–565.

Fama, Eugene, and G. William Schwert (1977) "Asset Returns and Inflation." *Journal of Financial Economics* 5, 115–146.

Feldstein, Martin (1980) "Inflation and the Stock Market." *American Economic Review* 70, 839–847.

Frankel, Jeffrey A. (1992) "Measuring International Capital Mobility: A Review." *American Economic Review* 82, 197–202.

Frankel, Jeffrey and Andrew Rose (1996) "Mean Reversion within and between Countries: A Panel Project on Purchasing Power Parity." *Journal of International Economics* 40, 209–224.

Gandolfi, Arthur E. (1982) "Inflation, Taxation and Interest Rates." *Journal of Finance* 37, 797–807.

Geske, Robert and Richard Roll (1983) "The Fiscal and Monetary Linkage between Stock Returns and Inflation." *Journal of Finance* 38, 1–33.

Guletkin, N. Bulent (1983) "Stock Market Returns and Inflation: Evidence from Other Countries." *Journal of Finance* 38, 49–65.

Hakkio, Craig and Mark Rush (1991) "Cointegration: How Short is the Long Run?" *Journal of International Money and Finance* 10, 571–581.

International Monetary Fund, *International Financial Statistics*. Various issues.

Isard, Peter (1992) "Uncovered Interest Parity." In John Eatwell, Murray Millgate, and Peter Newman (eds.), *The New Palgrave Dictionary of Money and Finance*. London: Macmillan.

Jorion, Phillipe and Richard J. Sweeney (1996) "Mean Reversion in Real Exchange Rates." *Journal of International Money and Finance* 15, 535–550.

Kaul, Gautam (1987) "Stock Market Returns and Inflation: The Role of the Monetary Sector." *Journal of Financial Economics* 18, 253–276.

Levi, Maurice (1995) *International Finance*. 3rd ed. New York, NY : McGraw Hill.

Longin, François and Bruno Solnik (1995) "Is the Correlation of International Equity Returns Constant: 1960–1990?" *Journal of International Money and Finance* 14, 1–26.

Lothian, James R. (1985) "Equilibrium Relationships between Money and Other Economic Variables." *American Economic Review* 75, 828–835.

Lothian, James R. (1997) "Multi-country Evidence on the Behavior of Purchasing Power Parity under the Current Float." *Journal of International Money and Finance* 16, 19–35.

Lothian, James R. and Mark P. Taylor (1996) "The Recent Float from the Perspective of the Past Two Centuries." *Journal of Political Economy* 104, 488–509.

Lucas, Robert E., Jr. (1980) "Two Illustrations of the Quantity Theory of Money." *American Economic Review* 70, 1005–1014.

Lucas, Robert E, Jr. (1982) "Interest Rates and Prices in a Two-Currency World." *Journal of Monetary Economics* 10, 335–360.

Mark, Nelson (1995) "Exchange Rates and Fundamental Evidence on Long-Horizon Predictability." *American Economic Review* 85, 201–218.

Melvin, Michael T. (1996) *International Money and Finance*. 5th ed. New York, NY : Harper Collins.

Mishkin, Fredric S. (1993) "Is the Fisher Effect for Real?" *Journal of Monetary Economics* 30, 195–215.

Mussa, Michael and Morris Goldstein (1993) "The Integration of World Capital Markets." In *Changing Capital Markets: Implications for Monetary Policy*. Kansas City, MO: Federal Reserve Bank of Kansas City.

Oh, Keun-Yeob (1996) "Purchasing Power Parity and Unit Root Tests Using Panel Data." *Journal of International Money and Finance* 15, 405–418.

Shiller, Robert J. and Pierre Perron (1985) "Testing the Random Walk Hypothesis: Power Versus Frequency of Observation." *Economics Letters* 18, 381–386.

Solnik, Bruno (1995) *International Investments*. 3rd ed. Reading, MA: Addison Wesley.