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The Behavior of Bond Yields Across Exchange-Rate Regimes And the Integration of Capital Markets

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In Europe as elsewhere, the debate over the appropriate exchange-rate regime continues. One of the major sources of contention is the effect of the regime on the economies involved. Did the move to floating exchange rates alter the behavior of important economic and financial variables within countries? Did it alter relationships among countries? If so, to what degree and in what direction?

On the simplest theoretical level the answers to these questions depend on whether the variables of interest are nominal or real. According to this line of reasoning, the exchange-rate regime, the conditions affecting a nominal variable, should only affect other nominal variables and not real variables. In short, the regime should be neutral.

Empirical evidence on this issue, however, has been mixed.[1] The dichotomy between nominal and real appears to be preserved for many, but not all, macroeconomic variables. Exchange rates themselves are the most notable exception, with the increased variability in nominal exchange rates under the float apparently carrying over into increased variability in real exchange rates (Mussa, 1986). This, in turn, has raised questions about other international financial relations.

McKinnon (1990), for example, has argued that the uncertainty engendered by such variability has reduced the international mobility of capital and thus led to increased divergences among interest rates in various countries. Although the verdict is not unanimous, evidence consistent with this hypothesis has been presented by a number of researchers.[2] The preponderance of such evidence, however, has come from analysis of data for the post-WWII period alone, particularly the current float.[3]

In this paper, in contrast, we focus on capital-market behavior over a long historical span. We analyze bond-yield behavior over time and across the United States and eight other major industrial countries during the 120-year period from 1871 to 1990. Our rationale for choosing these data as the subject of our analysis is twofold. The first is their richness, particularly with regard to

exchange-rate arrangements. The fact that these data allow us to compare bond-market behavior under the float and Bretton Woods with behavior under the gold standard is especially important. Many of the changes slated to occur in the EC would move Europe closer to the world of the pre-1914 gold standard. Experience during that era thus provides a useful touchstone for gauging the possible impact of greater European integration. Our second reason is more narrowly econometric. It is now well known that unit root tests and tests of cointegration have low power in short data spans.[4] Nevertheless, such tests can in principle provide us with useful information about the impact of the exchange-rate regime on yield behavior. Expanding the data beyond the post-WWII period alone therefore seemed to us to be a virtual necessity.

Several important findings come out of this analysis. Perhaps most interesting is that even though the exchange-rate regime has a substantial effect on the behavior of nominal yields it does not appear to matter much, if at all, for the behavior of real yields. Over the full sample period, real yields in all of the countries are mean reverting. We reject the hypothesis of a unit root in every instance for the full period and also for most of the subperiods that we analyze. Correspondingly, we find strong indications of relative convergence of real yields. We can reject the hypothesis of a unit root in the spreads between foreign and US real yields. We find that the cross-country standard deviations of real yields are neither significantly nor substantially different across the gold-standard, Bretton-Woods and current floating-rate periods. Additionally, we find essentially no difference in within-country standard deviations of real yields across these three periods. Finally, we find no significant difference in real-yield behavior between yields in the EC countries that are part of the EMS and other OECD countries in the period since 1979.

Section I of this paper outlines theoretical considerations. Section II describes the data used and details the empirical results. Section III presents a summary and conclusions for policy.

I. Theoretical Considerations

Of fundamental importance in both open-economy and closed-economy macroeconomics is the distinction between nominal and real interest rates. In the absence of uncertainty the nominal interest rate at time t, R_t, can be decomposed as:

$$R_t = er_t + \hat{p}_t^* \tag{1}$$

where er_t is the (*ex ante*) real yield and p_t^* is the anticipated rate of inflation over the life of the instrument.

The differential between two countries' nominal interest rates can then by extension be expressed as the sum of the differentials between the respective real interest rates and anticipated inflation rates:

$$R_t - R_t^F = (er_t - er_t^F) + (\hat{p}_t^* - \hat{p}_t^{F*}), \tag{2}$$

where the superscript F denotes the foreign country.

In long-run equilibrium, *ex ante* and *ex post* real rates of interest will be equal in each of the countries, as will be anticipated and actual rates of inflation. If purchasing power parity holds over the long run in rate-of-change form, then

$$\bar{\hat{s}}_t = \bar{\hat{p}}_t - \bar{\hat{p}}_t^F, \tag{3}$$

where $\hat{s}$ is the rate of change of the nominal exchange rate and a bar over a variable indicates a long-run equilibrium value.

Under fixed exchange rates, the result will be equality of long-run equilibrium inflation rates in the two countries. Hence, any difference between their nominal interest rates will be due to a difference in real interest rates. Under floating rates, in contrast, the two countries' inflation rates need not, and generally will not, be equal.[5] Differences in nominal interest rates can arise because

of differences in the rates of inflation in the two countries, differences in real interest rates or both.

In a world of perfect arbitrage, in which there are no transactions costs, and no risk aversion, real rates of interest on bonds, as well as on other assets, including both physical and human capital, would be equalized in the two countries. Nominal bond yield differences would then be due purely to differences in inflation rates. Since countries usually resort to floating exchange rates in situations in which policies toward inflation differ substantially, differences in inflation rates and thus nominal bond yields across countries will very likely be greater under floating than fixed exchange rates.[6]

At this level of abstraction, there is, however, no particular reason for there to be any greater difference in real rates of interest under floating exchange rates than under fixed. Put another way, the exchange-rate regime will be neutral in so far as interest-rate behavior is concerned: The regime, the arrangements affecting the nominal variable, the exchange rate, will be of no consequence for the behavior of real variables, including real interest rates.

Although agreement on the issue is not unanimous, there is a substantial body of evidence that appears inconsistent with equality of real interest rates among countries. One piece of evidence is the strong positive cross-country correlation between investment and savings first documented by Feldstein and Horioka (1980), and the subject of much discussion thereafter. A second comes from direct tests of real-interest rate equality based on the regression counterparts to (2):

$$r_t = a + b\, r_t^F + \epsilon_t \,. \tag{4}$$

In general, such tests have rejected the hypothesis that a is zero and that b is unity.[7]

A third type of evidence comes from indirect tests of real-interest equality that focus on auxiliary relations, relations which, if they held simultaneously, would translate into real-interest equality. Underlying these tests is a decomposition of the *ex ante* real-interest differential into a series of arithmetic components:

$$er - er^F = (R - R^F - fd) + (fd - \hat{s}^*) + (\hat{s}^* - \hat{p}^* - \hat{p}^{*F}). \quad (5)$$

The first component, the difference between the nominal-rate differential, $R - R^F$, and the forward premium on the domestic currency, fd, is the uncovered interest parity relation. Frankel, who has used such a breakdown rather extensively in his work, calls this the "country premium." The second, the difference between the forward premium and the anticipated change in the exchange rate, and the third, the anticipated change in the real exchange rate, he lumps together under the heading of "currency premia."

Since the bulk of the evidence shows that covered interest parity holds for major currencies, researchers have focused their attention on the latter two terms in equation (5), particularly the second term. In the main, the results here have been negative: Using quarterly and monthly data and forecast horizons of one to twelve months ahead, researchers generally find significant, time-varying differentials between fd and $\hat{s}^*$.[8] These have been interpreted variously as risk premia, reflections of rational learning in the presence of regime changes, and irrational behavior on the part of traders.[9] Whatever the reason underlying them, they do translate, other things being equal, into differentials between real interest rates internationally.

A major concern has been the effects of exchange-rate variability on these differentials. According to one line of reasoning, the uncertainty generated by frequent and substantial changes in real exchange rates has adversely affected the functioning of capital markets (McKinnon, 1990). Although international arbitrage still takes place, it does so in the context of increased risk. This, it is argued, creates widened cross-country differentials between real yields and decreases the flow of capital from one country to the other.

Whether this is an apt theoretical characterization is, however, open to debate. If there are substantial differences in domestic monetary policies, or if real shocks have varying impacts across countries, flexibility of exchange rates -- even if it means substantial variability -- may be desirable

from an efficiency standpoint. In the presence of fixed exchange rates, a monetary shock in one country, particularly if the country is large, will give rise to fluctuations in prices and output in other countries. Such was the experience under Bretton Woods (Darby, and Lothian, *et al*., 1983); it appears to have been the case recently within the EC. Flexible exchange rates may provide insulation in these circumstances. Additionally, exchange-rate flexibility may well be more efficient in the fundamental sense in which we think of price flexibility as being efficient. Compared with fixed rates, or pegged (but changing) rates, it may impart better information about the nature of shocks (Kimbrough, 1983); it may also increase the efficiency of resource allocation; and finally it may simply be a less costly in facilitating short-run adjustment than the alternative of changes in prices throughout the economy, accompanied perhaps with controls on trade and capital movements and exchange market intervention.

II. Data and Empirical Results

The principal data used in the empirical analysis which follows are annual observations for long-term bond yields (either government or high-grade corporate, depending upon availability) for nine countries: Canada, France, Italy, the Netherlands, Norway, Sweden, Switzerland, the United Kingdom and the United States. As a proxy for the corresponding *ex ante* real yields on these bonds we use the spreads between the nominal yields and contemporaneous rates of consumer price inflation.[10] The sample period for all countries other than the Netherlands and Switzerland is 1871 to 1990. For the latter two countries, lack of price-level data for earlier years forced us to begin somewhat later (1901 in the case of the Dutch real yields, and 1922 in the case of the Swiss).[11] Additional results reported at the end of this section are based upon a broader sample of 18 OECD countries over the much shorter period, 1956 to 1990.

II.A Overview of Real and Nominal Yield Behavior

Table 1 and Figures 1 and 2 provide an overview of the data. Table 1 contains summary statistics for real and nominal yields for various subperiods for each of the countries individually and for all of the countries on average. Figures 1 and 2 plot the yearly (cross-country) averages of these real and nominal yields for various aggregations of the data depending upon the periods for which the individual-country series are available.

Of particular interest in the charts is the difference between the behavior of real and nominal yields. The real yields appear highly variable both on a year-to-year basis and even over the subperiods themselves. Over the entire sample period, however, they tend to stabilize. For nominal yields, very nearly the opposite is the case. During episodes of high variability in real yields, the nominal yields are generally much more stable, but over much longer periods their variability increases. This contrast is especially apparent during the past four and a half decades. Nominal yields drift up substantially during these years, starting in the later years of the Bretton Woods era and continuing for much of the float. Real yields, despite their sizable fluctuations over the short and intermediate term, appear to have been much more nearly mean-reverting during these four decades, as well as over the sample period as a whole.

Table 1 tells approximately the same story. In every subperiod the real yields are more variable than the nominal. This disparity moreover is much greater earlier in the sample period. The standard deviations of the real yields are on average roughly the same under the gold standard and the float. The standard deviations of the real yields are, however, much greater than the standard deviation of the nominal yields under gold, but not very much different than the standard deviation of the nominal yields under the float.

The Fisher effect, as Fisher long ago pointed out, thus operated in a highly imperfect fashion.[12] And, consistent with Friedman and Schwartz's (1982, chapter 10) analysis of the United Kingdom and the United States, it only began to strengthen some time in the 1960s, as agents became aware of the increased inflation that was then underway. Even then, for the long-term yields

that we study it nevertheless remained weak. Most of the major fluctuations in the price level still appear to have caught market participants largely, though not completely, unaware.[13]

Despite this apparent lack of prescience on the part of market participants, the subperiod cross-country means of the real yields show very little movement from the start to the end of our sample period in comparison to those for the nominal yields. The mean real yield for the seven countries as a group under gold was is 3.56 per cent as opposed to 2.64 per cent under the float, a difference of 92 basis points. The mean nominal yield was 3.93 per cent under gold and 9.98 per cent under the float, a difference of slightly over 600 basis points. For most of the countries viewed individually we see the same thing.

Also of note in Table 1 is the pattern of variability of real interest rates within the various subperiods. In most cases, there is very little difference between variability under the gold standard, Bretton Woods, and the float.[14] For Bretton Woods versus the float there is absolutely no clear pattern of individual-country differences, and for all countries on average the float is actually the less variable period. The periods in which the data show the most variability are the two world wars and the interwar years. The wars, however, were exceptional. The interwar period, moreover, was characterized by a variety of exchange-rate regimes of varying and short durations. It is therefore difficult to disentangle regime effects from other effects, including those of the 1920 deflation and the Great Depression.[15]

II.B Mean Reversion

We investigated the question of level behavior further by conducting a series of unit-root tests for both the real and the nominal yields. Table 2 summarizes the results for the real yields, and Table 3 the results for the nominal yields for each of the countries separately and for the seven-country and the nine-country means, all for the full sample periods for which the data are available. The results shown are for conventional Dickey-Fuller (DF) tests based on an autoregression of the

form:

$$x_t = \mu + \beta\, x_{t-1} + u_t. \qquad (6)$$

The hypothesis to be tested is $\beta=1$. The finding that β is significantly less than unity is a rejection of the unit root hypothesis and implies that x_t is mean reverting. In addition to the DF tests, we ran both augmented Dickey-Fuller (ADF) tests and the heteroskedasticity robust tests of Phillips and Perron for the real yields. Since the results of these test were qualitatively similar to those from the DF tests, we report only the latter.

Particularly striking is the difference between the results reported in Tables 2 and 3. For the nominal yields we always fail to reject the hypothesis of a unit root. For the real yields, for each country individually and for both country aggregations, we always strongly reject the unit root null. Over the full period, therefore, we see yields behaving very much in accord with theory. The difference in inflation experience over time is reflected in a significant permanent component in nominal yields, but not in real. Over the long period, the persistent fluctuations in real yields apparent in Figure 2 largely cancel out.

Table 4, in which we present the results of similar Dickey-Fuller tests for the various regimes viewed individually, sheds further light on this behavior. In spite of short sample length, these results show strong rejections of the unit-root hypothesis in most instances. The full-period results therefore do not seem to be driven by one or two outliers, since such large movements are for the most part confined to the war and interwar years.

The only instance in which we were unable to consistently reject the unit root null was for the current float alone, in a further set of comparisons (not shown in the table) in which we subdivided the post-WWII period into its Bretton-Woods and floating-rate subperiods. This could mean that the float was indeed characterized by fundamentally different behavior. Alternatively, it may simply be due to the short sample period. We are inclined to accept the latter explanation, since

as Table 4 indicates we were able to reject the unit root hypothesis in every case in which the float and Bretton Woods periods were combined.

II.C Cross-Country Variability and the Convergence of Real Yields

The dichotomy between the behavior of nominal and real yields becomes even more apparent when we compare their variability across countries under the flaoting and fixed rates. We can see this in Figures 3 and 4, which plot the yearly cross-country standard deviations of the two series. Difference among countries in nominal yields clearly become greater during the two (peacetime) periods in which exchange rates were floating, the early interwar years and the current float. They are inconsequential by comparison in the fixed-rate periods, the classical gold-standard era and the Bretton- Woods period. The cross-country variability of real yields, in contrast, shows no such systematic difference across regimes. It is exceptionally high during both world wars and in a large portion of the interwar period, but appears to be approximately the same under gold, Bretton Woods and the current float, with some tendency to fall slightly through time.

The test results reported in Table 5 confirm these impressions. Underlying these tests is a series of dummy variable regressions of the form:

$$SD_{it} = \gamma + \lambda_1 D1 + \lambda_2 D2 + ... + \lambda\beta_j Dj + \epsilon_t, \quad (7)$$

where SD_{it} is the cross-country standard deviation of the ith variable (either the real or the nominal yield for either the seven countries or the full nine countries), the Ds are dummy variables for periods, γ and the λs are coefficients to be estimated, and ϵ is the error term assumed NID$(0,\sigma^2)$.

Differences between periods in the cross-country standard deviations of real yields are statistically significant, but this is due totally to the war and interwar observations. Differences among the gold, Bretton-Woods and floating-rate periods are never statistically significant as a group, nor are the differences between any two of these three regimes significant. This remains the

case, moreover, when we subdivide the Bretton Woods period in 1959-1960, and thus isolate the 1960s from the years of inconvertibility and immediate postwar economic turbulence.

For nominal yields we see the opposite. The dummies for World War I and the interwar years are not significant while the dummies for the remainder of the periods are. In the case of nominal yields, variability was clearer greater during the World War II and Bretton Woods years than in earlier periods and greater still under the float.

We present further evidence on convergence in Table 6 in which we report the results of unit root tests applied to differentials between foreign and US real yields. Consistent with the results reported for the absolute levels we are able to reject the unit root hypothesis against the alternative of a first-order autoregressive process in all instances.[16] For the Netherlands, however, the estimated autoregressive coefficient is greater than unity in absolute value, though neither significantly nor substantially so. For all countries individually we are also able to reject the unit root over the post-WWII period alone.

II.D EMS versus Non-EMS Countries

Finally, we present results for a group of eighteen OECD countries during the floating-rate and Bretton-Woods years. This sample is divided equally into EMS and non-EMS groups.[17]

We analyze these data for two reasons. The first is the lower variation in real exchange rates within the EMS bloc of countries. Considering them separately provides, as it were, an additional experiment for judging the effects of exchange-rate variability on real interest rates. Our second reason is interest in the EMS *per se*. One of the economic arguments advanced on behalf of the European Exchange Rate Mechanism (ERM) and the proposed single currency is elimination of the costs associated with exchange-rate fluctuations. Since the ERM is a step in the direction of fixity, albeit a faltering one during the past year, it may be useful to analyze experience to date.

To that end, we have prepared charts like those presented above for the long-term data, in

which we plot the cross-country standard deviations of real and nominal interest rates. The interesting aspect of these charts is that they show very little in the way of differences in real-yield behavior under the ERM. Nominal yields are decidedly more convergent, but real yield convergence, though noticeably greater for the EC countries in the early 1980s, is roughly the same as the degree of convergence for the other OECD countries later on. For the period 1979 to 1990 as a whole, there is in fact no statistically significant difference between the convergence measures for the two groups of countries.[18]

The observed disparity between real-yield and nominal-yield behavior in the EC countries relative to the other OECD countries is consistent with developments during the course of 1992. It suggests that the convergence of nominal yields was in a sense artificial, being based on the expectation of inflation convergence that in fact had only partially taken place. Once the eventuality of such a convergence got called into question, current fundamentals became more important, the traditionally higher inflation countries saw their currencies come under speculative pressure, and devaluations ensued.

III. Conclusions

Government imposed barriers to capital flows were greatly reduced during the 1970s and 1980s and have been practically eliminated in most industrialized nations in recent years. Over the same period, financial innovation -- the development of a wide range of new financial instruments, of organized markets in foreign currency futures and options, and of new techniques in international corporate finance -- proceeded at an unprecedented pace. At the same time, there was a revolution in electronic communications that made real-time financial information a reality.

Based on historical experience, one might very well have assumed that this combination of factors would cause real interest rates, if not nominal, to converge internationally. In fact, they did not, since for a sizable portion of the floating-rate years cross-country spreads between real yields were actually greater than in most of the 1960s. One explanation for this seeming anomaly has centered around the exchange-rate regime and the volatility of exchange rates, both nominal and real, under the floating rate system. This in turn has given rise to calls for a return to fixed exchange rates, and in the case of the EC, has provided one of the arguments for the proposed monetary union.

On a theoretical level, however, the argument is flawed: The exchange-rate regime is itself an endogenous variable. Historically, there have been few, if any, experiments in which a regime was chosen in more or less random fashion.[19] As a result, the researcher generally has to exercise great care in not confusing so-called "regime effects" with the effects of broader macroeconomic, including monetary-policy, developments. We have tried to circumvent that problem by analyzing as broad a sample, both geographically and temporally, as possible and thus to eke out a few more effective degrees of freedom that will enable us to distinguish between the effects of the regime itself and these other factors.

The principle conclusion that we reach on the basis of this analysis is that the exchange rate regime matters little, if at all, for the behavior of real interest rates. Nominal bond yields actually do behave very differently in the latter third of our 120 year sample period than in the initial third.

On average, they are both substantially higher, substantially more variable, and substantially more divergent across countries for much of the post-WWII period than under the gold standard. For real yields, the picture is entirely different. The period averages, period standard deviations and measures of convergence are much more nearly equal across the gold-standard, Bretton-Woods and current floating-rate regimes. Relative convergence of real yields among countries also clearly takes place, and, if anything, has been slightly greater in the floating-rate period *as a whole* than under either gold or Bretton Woods. The only between-period difference of note is the interwar period versus these other three periods, but this appears to us to have much more to do with the economic turbulence of that era than with the exchange-rate regime, which did in fact vary considerably within the interwar period itself.

One implication of these results is clear. A move to fixed exchange rates, other things remaining the same, is not likely to matter greatly from the standpoint of capital market integration. In the absence of war-time disruptions or truly substantial economic dislocations of the type that took place in the years immediately following World War I and then later in the 1930s, bond market behavior has been of a fairly constant sort.

Volatility of exchange rates may indeed have been disruptive early on under the float, but then agents evidently became more accustomed to operating in the new regime, and institutions developed to cope with the risk of exchange-rate changes: financial innovation too has had a strong endogenous element to it. The result was a return to the *status quo*. If the exchange-rate regime has indeed been of little importance, then what accounts for the continued cross-country divergences in the levels of real yields and what are the implications of such divergences more generally? Here we feel on considerably less firm ground. One obvious possibility is lack of arbitrage internationally due to impediments in the bond markets themselves or to faulty information. The problem with that argument is that the relationships we observe are too long-lived. They persist in basic form across the gold standard when capital controls had not yet been invented, and in recent

years when such controls have been absent. And because they show up in annual data, they are unlikely to be heavily influenced by problems related to the rapidity with which information is disseminated or to irrationality or other idiosyncratic behavior on the part of market participants. We are left therefore with an appeal to specific country characteristics, risk of various sorts, the liquidity characteristics of different markets, and perhaps most importantly differences in the real returns to real assets across countries.

Table 1
Summary Statistics by Period

	Canada	France	Italy	Norway	Sweden	U.K.	U.S.	Neth.	Switz.	All
Nominal Rates										
Gold (1870-1914)										
Mean	3.81	3.59	4.70	4.23	4.02	2.96	4.23	3.89	3.87	3.93
Std. Dev.	0.69	0.72	1.08	0.43	0.44	0.23	0.93	0.56	0.22	0.63
WWI (1915-1918)										
Mean	4.60	4.76	4.89	5.80	4.33	4.28	4.25	4.65	4.93	4.72
Std. Dev.	0.70	0.28	0.55	0.34	0.24	0.32	0.34	0.27	0.35	0.38
Interwar (1919-1939)										
Mean	4.59	4.61	5.88	5.09	4.48	4.11	4.17	4.51	4.62	4.67
Std. Dev.	0.83	0.82	0.61	0.80	0.42	0.71	0.69	0.78	0.89	0.73
WWII (1940-1945)										
Mean	3.12	3.25	6.36	3.30	3.03	3.12	2.63	3.73	3.41	3.55
Std. Dev.	0.12	0.40	1.03	0.57	0.23	0.16	0.05	0.44	0.33	0.37
Bretton Woods (1946-1973)										
Mean	4.58	5.54	6.06	4.11	4.39	5.33	4.05	4.82	3.53	4.71
Std. Dev.	1.57	0.96	0.69	1.10	1.71	1.88	1.43	1.45	0.86	1.29
Float (1974-1990)										
Mean	10.47	10.53	12.93	10.26	10.73	11.80	9.89	8.32	4.92	9.98
Std. Dev.	2.07	2.45	3.74	2.71	1.99	2.67	2.15	1.44	1.02	2.25
Real Rates										
Gold (1870-1914)										
Mean	3.35	3.35	3.99	3.52	3.51	2.78	4.42	2.83	N.A.	3.56
Std. Dev.	1.58	1.58	5.05	4.03	3.52	3.56	3.91	2.51	N.A.	3.28
WWI (1915-1918)										
Mean	-6.21	-13.30	-19.07	-19.80	-16.22	-11.13	-7.16	-7.84	N.A.	-12.59
Std. Dev.	6.47	5.28	9.81	8.71	9.63	8.19	7.09	5.56	N.A.	7.59
Interwar (1919-1939)										
Mean	5.36	-1.34	3.18	7.97	5.99	4.18	4.63	6.33	6.39	4.71
Std. Dev.	6.32	12.25	12.06	9.68	7.11	8.25	8.25	5.53	5.40	8.38
WWII (1940-1945)										
Mean	-1.14	-18.91	-38.92	-5.32	-2.32	-3.73	-2.16	-5.60	-3.47	-9.06
Std. Dev.	1.69	8.83	31.80	7.94	5.86	5.77	3.01	5.87	5.01	8.42
Bretton Woods (1946-1973)										
Mean	1.14	-4.14	-1.63	0.04	0.38	1.14	0.48	0.47	1.32	-0.09
Std. Dev.	3.50	13.39	13.12	3.58	3.15	2.83	3.81	3.02	1.66	5.34
Float (1974-1990)										
Mean	3.28	2.76	0.88	3.11	2.45	2.26	4.39	3.71	0.94	2.64
Std. Dev.	3.58	2.99	4.51	4.88	2.98	3.96	3.01	2.63	1.85	3.38

Table 2

Unit Root Tests for Real Yields, 1872-1990

$$r_t = \mu + \beta r_{t-1} + e_t$$

	μ	β	DF	R^2	SEE
Canada	1.214 0.393	0.546 0.078	5.819	0.296	3.656
France	-0.226 0.667	0.704 0.066	4.491	0.493	7.241
Italy	-0.203 0.898	0.749 0.061	4.097	0.561	9.776
Netherlands	0.780 0.439	0.531 0.079	5.957	0.279	4.049
Norway	0.891 0.587	0.611 0.073	5.305	0.373	6.148
Sweden	0.679 0.429	0.690 0.067	4.629	0.475	4.416
Switzerland	0.710 0.361	0.509 0.074	6.647	0.418	2.680
UK	0.946 0.479	0.483 0.081	6.377	0.232	4.984
US	1.434 0.499	0.500 0.080	6.240	0.250	4.838
7 Countries	0.385 0.393	0.742 0.062	4.147	0.548	4.166
9 Countries	0.141 0.390	0.753 0.069	3.567	0.642	3.132

Note: Figures beneath the coefficients are standard errors. DF is the Dickey-Fuller statisitic and SEE is the standard error of estimate.

Table 3

Unit Root Tests for Nominal Yields, 1871-1990

$$R_t = \mu + \beta R_{t-1} + e_t$$

	μ	β	DF	R^2	SEE
Canada	0.067	0.995	0.248	0.952	0.585
	0.118	0.021			
France	0.163	0.977	0.930	0.931	0.709
	0.144	0.025			
Italy	0.206	0.973	1.081	0.926	0.895
	0.308	0.025			
Norway	0.088	0.992	0.386	0.950	0.572
	0.122	0.021			
Sweden	-0.048	1.023	-1.394	0.970	0.465
	0.095	0.016			
UK	0.311	0.951	1.525	0.883	1.148
	0.192	0.032			
US	0.076	0.989	0.546	0.957	0.517
	0.107	0.019			
Netherlands	0.121	0.981	0.717	0.924	0.506
	0.135	0.026			
Switzerland	0.539	0.880	1.983	0.722	0.543
	0.261	0.061			
7 Countries	0.023	1.004	-0.259	0.970	0.461
	0.049	0.016			
8 Countries	0.024	1.004	-0.220	0.969	0.453
	0.098	0.017			
9 Countries	0.109	0.995	0.217	0.960	0.517
	0.139	0.022			

Note: Figures beneath the coefficients are standard errors. DF is the Dickey-Fuller statisitic and SEE is the standard error of estimate.

Table 4

Unit Root Tests for Real Yields, Various Subperiods

	1872-1914	1919-1939	1949-1990
Canada	-2.728	-3.362	-3.942
France	-6.120	-3.420	-10.95
Italy	-5.874	-2.747	-3.971
Netherlands	NA	-4.054	-2.655
Norway	-4.125	-3.252	-3.275
Sweden	-4.033	-4.632	-3.532
Switzerland	NA	-5.857	-3.800
UK	-5.998	-3.188	-5.291
US	-4.415	-3.457	-3.091

Note: Figures are Dickey-Fuller (DF) statistics.

Table 5

Regressions of Yearly Cross-Country Standard Deviations on Dummy Variables for Periods: 1870-1990 and Subperiods

	Nominal			Real	
Dummy	**8 Countries 1870-1990**	**9 Countries 1907-1990**	**7 Countries 1871-1990**	**7 Countries 1871-1990**	**9 Countries 1922-1990**
Constant	0.593	0.376	2.844	2.844	5.189
	12.415	3.004	4.566	4.720	4.797
WWI	-0.045	0.144	5.796	5.796	
	-0.270	0.663	2.686	2.777	
Inter War	0.116	0.307	3.396	3.396	
	1.370	0.083	3.099	3.203	
WWII	0.602	0.742	13.744	13.744	9.376
	4.328	3.878	7.643	7.902	4.329
B. Woods	0.410	0.708			
	5.322	4.988			
B. Woods1				3.535	
				2.882	
B. Woods2				-0.955	
				-0.779	
B. Woods × Float			1.290	-1.337	
			1.291	-0.964	
Float	1.588	2.537	-1.927	-0.637	-1.477
	17.418	16.703	-1.517	-0.558	-1.047
R^2	0.741	0.865	0.386	0.430	0.338
SEE	0.320	0.354	4.132	3.997	4.590
F	54.915	123.125	12.039	12.194	8.292

Notes: The periods for which the dummy variables take the value one are as follows: WWI, 1914-1918; Inter-War, 1919-1939; WWI, 1940-1945; B. Woods, 1946-1973; B.Woods 1, 1946-1959; B. Woods 2, 1960-1973; Float, 1974-1990. Figures beneath the coefficients are t values. the F statistic is to test the hypothesis that all of the coeffiicents of the dummy variables are zero.

Table 6

Unit Root Tests for Foreign vs. US Real Yields, 1871-1990

$$(r_i - r_{US})_t = \mu + \beta (r_i - r_{US})_{t-1} + e_t$$

	μ	β	DF	R^2	SEE
Canada	-0.193	0.104	9.712	0.011	3.323
	0.305	0.092			
	-0.633	1.131			
France	-1.544	0.580	5.558	0.336	6.402
	0.653	0.075			
	-2.366	7.688			
Italy	-1.217	0.670	4.811	0.448	9.412
	0.899	0.069			
	-1.354	9.752			
Norway	-0.348	0.417	6.936	0.174	5.510
	0.508	0.084			
	-0.686	4.966			
Sweden	-0.514	0.281	8.111	0.079	4.693
	0.435	0.089			
	-1.181	3.166			
United Kingdom	-1.012	0.049	10.302	0.002	4.510
	0.653	0.092			
	-2.378	0.533			
Netherlands	0.186	-0.110	10.493	0.012	4.603
	0.488	0.106			
	0.382	-1.041			
Switzerland	-0.388	0.592	4.572	0.399	3.107
	0.653	0.089			
	-0.594	6.626			

Note: Figures in the first line beneath the coefficients are standard errors; figures in the second line are t values. DF is the Dickey-Fuller statistic and SEE is the standard error of estimate.

Table 7
Correlations of Real Yields
1872-1990 and Subperiods

1872-1990

	Canada	France	Italy	Norway	Sweden	UK
France	0.583					
Italy	0.496	0.733				
Norway	0.693	0.361	0.386			
Sweden	0.678	0.402	0.322	0.771		
UK	0.715	0.526	0.537	0.645	0.730	
US	0.803	0.642	0.535	0.630	0.652	0.678

1872-1914

	Canada	France	Italy	Norway	Sweden	UK
France	0.357					
Italy	0.253	0.184				
Norway	0.166	0.274	0.482			
Sweden	0.285	0.137	0.335	0.783		
UK	0.204	-0.027	0.469	0.439	0.423	
US	0.481	0.410	0.179	0.452	0.501	0.238

1923-1939

	Canada	France	Italy	Neth.	Norway	Sweden	Switz.	UK
France	0.303							
Italy	0.461	0.545						
Neth.	0.728	0.484	0.324					
Norway	0.507	0.095	0.387	0.551				
Sweden	0.571	0.204	0.204	0.793	0.644			
Switz.	0.651	0.498	0.340	0.811	0.680	0.867		
UK	0.646	0.252	0.238	0.770	0.584	0.950	0.801	
US	0.800	0.353	0.570	0.628	0.449	0.463	0.643	0.443

1949-1990

	Canada	France	Italy	Neth.	Norway	Sweden	Switz.	UK
France	0.733							
Italy	0.608	0.433						
Neth.	0.676	0.379	0.394					
Norway	0.666	0.292	0.474	0.687				
Sweden	0.736	0.465	0.508	0.650	0.732			
Switz.	0.314	0.148	0.537	0.156	0.375	0.296		
UK	0.642	0.477	0.411	0.418	0.524	0.637	0.318	
US	0.814	0.595	0.513	0.667	0.670	0.731	0.223	0.628

1949-1974

	Canada	France	Italy	Neth.	Norway	Sweden	Switz.	UK
France	0.773							
Italy	0.467	0.432						
Neth.	0.575	0.225	0.316					
Norway	0.581	0.109	0.349	0.580				
Sweden	0.696	0.375	0.356	0.448	0.704			
Switz.	0.216	0.090	0.652	0.067	0.300	0.374		
UK	0.685	0.557	0.284	0.292	0.450	0.685	0.226	
US	0.816	0.662	0.428	0.425	0.448	0.657	0.118	0.517

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Notes

1. Baxter and Stockman (1989), using multi-country data, and Baxter (1991), using data for the United States alone, present evidence that the exchange-rate regime is neutral with respect to real macroeconomic behavior. Darby and Lothian (1989) present evidence that the long-run insulation properties of floating exchange rates held under the current float. They show additionally that the correlations of both real GDP growth in the US and other OECD and in real bond yields increased. Barone-Adesi and Yeung (1990) present evidence that output variability was lower both across and within countries under the current float than under Bretton Woods. Mussa (1986), however, shows that real exchange rates have been more variable under floating than fixed rates, and Cushman in a number of studies (e.g. 1986) has presented evidence of adverse effects of floating rates on international trade. Other studies (e.g. Bailey, Tavlas and Ulan, 1986), however, reach opposite conclusions with regard to trade flows. For a critical review of studies on this subject, see Edison and Melvin (1990).

2. In the main, this evidence indicates less than perfect capital mobility under the float as opposed to a decrease in capital mobility with the advent of floating rates. We review this evidence in the next section of the paper.

3. Studies of capital market integration using historical data include Eichengreen's investigation of interwar bond markets (1988), Neal's study (1985) of equity-market arbitrage, and Friedman and Schwartz's (1982, Chapter 10) investigation of the relations between short-term and long-term interest rates in The United States and the United Kingdom over the period 1870 to 1975. Also see Bayoumi (1990), and Mills and Wood (1992).

4. Shiller and Perron (1985) show that the span of the data rather than the number of observations *per se* matters greatly for test power. This issue has proven important in interpretations of the purchasing power parity relation (Lothian and Taylor, 1992).

5. See Lothian (1985), and Darby and Lothian (1989) for evidence on this subject.

6. See Savvides (1991) for a study of the factors affecting the choice of regimes.

7. These studies include Cumby and Mishkin (1986), Mark (1985), Merrick and Saunders (1986) and Mishkin (1984b). Goodwin and Grennes (1993 forthcoming), however, presents evidence consistent with international real-interest equality, given transactions costs. Johnson (1992) finds no difference across regimes in the links between Canadian and U.S. interest rates.

8. Frankel (1992, p. 200) in reviewing the evidence describes these currency premia as "substantial and variable" and responsible for approximately the entirety of [the] real interest differentials vis-à-vis the United States. In addition, see Frankel (1991) and Hodrick (1987) and Levich (1985) for overviews of this literature.

9. The risk premium explanation has been most prevalent. Froot and Frankel (1987 and 1990) present evidence of irrationality on the part of traders. Evans and Lewis (1992), however, show that

this latter explanation and rational learning in the face of change in the inflation regime are observationally equivalent.

10. We refer to these measures as "real yields," though in fact as we point out below they are highly imperfect proxies over much of our sample period for the true *ex ante* real yield.

11. The principal sources of data were the (unpublished) series used in Bordo and Jonung (1987) and Bordo (1991), that Michael Bordo graciously provided us. We also used Homer (1977) and Mitchell (1975) for additional historical data. Both the yield and the price series were updated from the International Financial Statistics. The individual series used in each instance and their sources are described more fully in an appendix available from the authors on request.

12. Fisher's own assessment is particularly interesting. In his Theory of Interest (p. 415) he presents a table of standard deviations of nominal and real *ex post* short-term interest rates in London, New York, Berlin, Calcutta, and Tokyo for varying subperiods over the long period 1825 to 1927. In describing the table he states: "This table shows that the real rate of interest expressed in terms of commodities is from seven to thirteen times as variable as the market rate of interest expressed in terms of money. This means that men are unable or unwilling to adjust at all accurately and promptly the money rates to changed price levels."

13. In addition to the discussion of this issue in Friedman and Schwartz (1982, chapter 10), see Evans and Wachtel (1992) and Tanner (1992).

14. Note that this conclusion is not dependent on our use of 1870-1914 as the gold standard period. When we begin in 1879, the year the United States returned to gold, we obtain similar results to those reported for the period beginning in 1870.

15. Eichengreen (1988), in a study using monthly data, divided the interwar period into three subperiods according to the exchange-rate arrangements that prevailed: pre-1925, floating rates; 1925-1931, gold; post-1932, managed floating rates. We compared real yields in these subperiods with real yields under gold, Bretton Woods and the current float. The standard deviations for 1919-1925 were highest in each instance. We found essentially no difference otherwise between variability of real yields in the two remaining floating rate periods and in the three fixed-rate periods. Since 1919-1925 was a time of unusually severe monetary and price deflation, coupled with substantial problems in the real economies of many of the countries in our sample (most notably the United Kingdom), it appears reasonable to attribute the substantial variability of real yields during those years to these factors as opposed to the exchange-rate regime *per se*.

16. See Neusser (1991) for results consistent with these for the United States and six other countries over the period 1960-1990.

17. The 18 countries included in this sample were Australia, Austria, Canada, Japan, Norway, Portugal, New Zealand, Sweden, Switzerland, the United States, Belgium, Denmark, France, Germany, Ireland, Italy, the Netherlands, and the United Kingdom. We defined the group of

countries in the ERM as these last eight countries and thus include the United Kingdom, even though it only joined relatively late in the period. Excluding both the United Kingdom and Portugal did not substantially alter the results.

18. To test the hypothesis that the two groups of countries were homogeneous, we ran a regression of the yearly cross-country standard deviations of the real yields for the two groups separately on a dummy variable for the ERM countries. The coefficient of the dummy was negative, but not significant at conventional levels.

19. One possible exception is Japan following the Meiji Restoration (see Lothian, 1990).