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# Real Interest Rate Parity: Evidence from Industrialized Countries*

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This paper tests real interest parity (RIP) for a group of industrialized countries using quarterly data on long-term and short-term interest rates from 1957:1 to 2003:1. The paper looks at such issues as the lack of power in the standard unit root tests, spans of data, the base country, and the high volatility of exchange rates under the current float as possible reasons for the weak support for RIP. Overall, the standard ADF unit root test provides more supporting evidence in favor of RIP than the more powerful ADF-GLS test and the KPSS stationarity test, and the results do not seem to be sensitive to the choice of the base country. Lack of power seems to be an issue in short samples for the standard ADF test and the ADF-GLS test. The paper also investigates the behavior of real interest differentials (RIDs) across the Bretton Woods era and the current float. The results are consistent with the 'neutrality proposition', and indicate smaller RIDs post-Bretton Woods; thus, the claim that the current float caused RIDs to widen is not supported. Estimated speeds of convergence to RIP are between two to three quarters for both long-term and short-term RIDs and regardless of the base country.


*Key Words*: Real interest rate parity; Real interest differentials; Financial integration; Unit root tests.
*JEL Classification Numbers*: F36, E40, C12.

## 1. INTRODUCTION

The last thirty years of the past century have witnessed two important changes in the world economy: first, the collapse of the Bretton Woods system of fixed exchange rate in 1973 and the transition to the flexible

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rate system, and second, the increase in the degree of international financial integration among countries facilitated by the removal of many capital controls and barriers to the international movement of capital across national boundaries. Whereas the increase in the degree of international financial integration should equalize real interest rates across countries, this equalization may not be obtained under systems of flexible exchange rates due to high exchange rates variability and foreign exchange risk premium (Frankel, 1989; Wu et al., 2000).

The notion that real interest rates should be equal across countries is known as "real interest rate parity," (RIP), which, as a measure of international financial markets integration, is of practical importance since if the parity holds, the ability of the domestic monetary authority to influence internal real interest rates and other variables that depend upon them will be severely limited to the extent to which the monetary authority can influence the world real rate of interest (Mark, 1985a). [1]

A large number of studies have been undertaken to test RIP using different econometric techniques. The results are mixed, however. Early empirical studies (see, for example, Mishkin, 1984; Mark, 1985b; and Cumby and Mishkin, 1986) used regression analysis (Ordinary Least Square (OLS)) to test RIP and found no or little evidence in favor of RIP.[2] Nevertheless, with the new developments in econometrics regarding unit root testing and cointegration, the results of the early empirical studies must be interpreted with caution. There is some evidence that real interest rates are integrated of order one,[3] e.g., they are not stationary, in which case standard regression analysis will not be valid and the OLS estimators will be inconsistent.[4]

Using the new developments in econometrics, empirical studies (see, for example, Meese and Rogoff, 1988; Edison and Pauls, 1993; Goodwin and Grennes, 1994; Wu et al., 2000; and Obstfeld and Taylor, 2002) have shifted to investigate the time-series properties of real interest rates and real interest differentials (RIDs). The results are again mixed, with different studies using different tests and different sample sizes reaching different results regarding the stationarity and cointegration of RIRs and RIDs. The mixed

[1] There are five measures of international financial integration: 1- closed interest parity, 2- covered interest parity, 3- uncovered interest parity, 4- real interest parity, and 5- the Feldstein-Horioka condition.

[2] This literature was based on regressing the domestic real interest rate on its foreign counterpart and test the joint null hypothesis that the intercept and slope are equal to 0 and 1, respectively.

[3] There is also some evidence that real interest rates are stationary with structural breaks, see, for example, Goldberg et al. (2003).

[4] This is known as spurious, or nonsense regression, which arises when we regress one nonstationary variable on one or more nonstationary variables (see Granger, C.W. J. and P. Newbold, 1974).

results have led some economists to question the power of these tests given the increasing globalization of capital markets.

Most of the previous literature on RIP has employed short spans of data for the post-1973 era, and used standard unit root tests, such as the Augmented-Dickey Fuller (ADF) test and Philips-Perron (PP) test. It is now widely accepted that these tests have low power and size distortion and the null hypothesis of a unit root for many aggregate time series data cannot be rejected unless there is strong evidence against it.[5] DeJong et al. (1992) argued that the Dickey-Fuller unit root test has low power against trend stationary processes. Diebold and Rudebusch (1991) showed that the unit root tests proposed by Dickey and Fuller have low power against fractionally-integrated processes. Perron (1989) argued that most macroeconomic variables are not unit root processes; rather they are trend stationary processes with structural breaks. Therefore, if a series contains a structural break, standard unit root tests will fail to reject the null of a unit root when, in fact, the null is false. Shiller and Perron (1985) showed that unit root tests have low power in short time spans.[6]

To overcome these problems, more recent studies (see, for example, Gagnon and Unferth, 1995; Ong et al., 1999; MacDonald and Nagayasu, 2000; Holmes, 2002) have used the panel approach proposed by Levin and Lin (1992 and 1993), and were able to find evidence in favor of RIP. Others have used multivariate techniques, models with structural breaks, and nonlinear models to test RIP (see, for example, Wu, Jyh-Lin et al., 2000; Mancuso et al., 2003; Holmes et al., 2004; and Chung et al., 2004).

Therefore, and given the substantial removal of many barriers to the movement of capital across national boundaries and the increase in the degree of international financial integration among countries over the past thirty years, the reason(s) for the failure to find evidence in favor of RIP may be due to: 1- lack of power in standard unit root tests, 2- short spans of data, 3- the base country, 4- high exchange rates volatility during the current float. Frankel (1989, page 2) says:

[5]ADF tests have low power means that we are likely to make type II error. The power of the test is the probability of rejecting a false null hypothesis. The size of the test is the probability of making type I error. Type I error is the probability of rejecting a true null hypothesis, and type II error is the probability of accepting a false null hypothesis.

[6]In a related literature to the PPP theory, Froot and Rogoff (1994) show that if the real exchange rate follows a stationary AR(1) process and the half-life deviations is three years, it would require 72 years of data to reject the null hypothesis of a unit root at the 5 percent significance level. Frankel (1986 and 1990) pointed out that if the speed of convergence to PPP is extremely slow, then it might require sufficiently long spans of data to be able to reliably reject the random walk hypothesis in the real exchange rate. He tested a long data set on the US$-DM real exchange rate for the period 1869-1984, where he was able to reject the random walk hypothesis.

> "Perfect capital mobility, in the sense of low barriers to the movement of capital across national boundaries, does not imply the international equalization of nominal or real interest rates, however. The reason is high exchange rate variability under floating exchange rates (which may itself be in part a result of high capital mobility)."

In this paper, we address these issues by testing RIP for a group of industrialized countries on quarterly data for the period 1957:1-2003:1 using the more powerful ADF-GLS unit root test proposed by Elliot et al. (1996), and the KPSS stationarity test proposed by Kwiatkowski, Phillips, Schmidt, and Shin (1992) (KPSS test, hereafter). Elliot et al. (1996) propose ADF-GLS unit root tests, which are more powerful than the standard unit root tests. The KPSS test, in contrast to standard unit root tests, tests the null hypothesis of stationarity against the alternative of a unit root, which can be used, as proposed by Kwiatkowski et al (1992), to complement unit root tests, such as the ADF test, or PP test, or any other unit root test that makes unit root the null hypothesis and stationarity the alternative hypothesis.

The U.S. and Germany are used as base countries to see if the results are sensitive to the choice of the base country. The analysis is conducted for the entire period from 1957:1 to 2003:1 and for different sub-periods to see how RIDs have changed over time. The entire period is divided into two major sub-periods: 1957:1-1973:1, which corresponds to the Bretton Woods era of fixed exchange rate system, and 1973:2-2003:1, which corresponds to the current float. Simple OLS models are estimated for the entire period with a dummy variable that takes the value one for observations beginning in 1973:2 and zero otherwise to capture the effect of the transition to the current float on RIDs and to see if the current float has caused RIDs to widen as claimed.

The rest of the paper is organized as follows: section one presents the econometric methodology, which contains the theoretical background on RIP, the unit root tests, the OLS model, and the data. Section two provides the results and analysis, and section three gives the summary and conclusions.

### 1.1. Econometric methodology

### 1.2. Real interest parity

Ex ante real interest parity states that real interest rates should be equalized across countries. The theoretical arguments as to why real rates should be equalized across countries follow from the following four parity conditions:

$$\Delta s^e_{t+1} = i_t - i^*_t \tag{1}$$
$$\Delta s^e_{t+1} = \Delta p^e_{t+1} - \Delta p^{e^*}_{t+1} \tag{2}$$
$$r^e_t = i_t - \Delta p^e_{t+1} \tag{3}$$
$$r^{e^*}_t = i^*_t - \Delta p^{e^*}_{t+1} \tag{4}$$

equation (1) is uncovered interest parity (UIP), which states that the expected change in the exchange rate (defined as the number of units of the domestic currency per unit of the foreign currency) over a period of time should be equal to the interest differential over the same period. Equation (2) is ex ante relative purchasing power parity (PPP), which states that the expected change in the exchange rate over a period of time should be equal to expected inflation differential over the same period. Equation (3) is ex ante domestic Fisher equation, which states that ex ante real interest rate is equal to the nominal interest rate minus the expected inflation, and equation (4) is ex ante foreign Fisher equation. $i$is the nominal interest rate, $s^e_{t+1}$ is the logarithm of the expected nominal exchange rate at time $t+1$, $p^e_{t+1}$ is the logarithm of the expected price level at time $t+1$, $r^e_t$ is ex ante real interest rate at time $t$, $\Delta$ is the first difference operator, $e$stands for ex ante or expected variable and an asterisk denotes a variable for the foreign country. Combining equations (1) and (2) yields

$$i_t - \Delta p^e_{t+1} = i^*_t - \Delta p^{e^*}_{t+1} \tag{5a}$$
$$r^e_t = r^{e^*}_t \tag{5b}$$

the ex ante RIP, that is, if the parity conditions (1) – (4) hold, then ex ante real interest rates must be equalized across countries.

Equation (5) is not testable in its present form since expected variables, such as $\Delta p^e_{t+1}$and hence $r^e_t$, are not observable in the current period and there is no direct measure of expected inflation. Therefore, a proxy for expected inflation must be used. The standard approach in the literature is to make use of the rational expectations theory pioneered by Muth (1961), in which case an ex ante variable will be equal to it's ex post value plus a stationary error term. Thus, assuming rational expectations yields

$$\Delta p^e_{t+1} = \Delta p_{t+1} + \omega_{t+1} \tag{6a}$$
$$\Delta p^{e^*}_{t+1} = \Delta p^*_{t+1} + \omega^*_{t+1} \tag{6b}$$

Which states that expected inflation ($\Delta p^e_{t+1}$) at time $t+1$ equals the actual inflation ($\Delta p_{t+1}$) at time $t+1$ plus a random forecast error($\omega_{t+1}$)that is serially uncorrelated with zero mean and an asterisk denotes a variable for the foreign country. Combining equations (5a) and (6) yields

$$i_t - \Delta p_{t+1} - \omega_{t+1} = i_t^* - \Delta p_{t+1}^* - \omega_{t+1}^* \quad (7a)$$
$$r_t - r_t^* = \eta_{t+1} \quad (7b)$$

ex post real interest parity and $\eta_{t+1} = \omega_{t+1} - \omega_{t+1}^*$ represents real interest differential (RID) or deviations from ex post RIP. For long-run RIP to hold, RID be should be a zero mean stationary process, that is, RID should be mean-reverting.

## 1.3. Unit root tests

### *1.3.1. The ADF-GLS Test*

Standard unit root tests, such as the ADF test, lack power; therefore, these tests have been supplanted by improved tests. The more powerful ADF-GLS test has been proposed by Elliott et al. (1996), which is similar to the ADF test, but can achieve significant power gains over standard unit root tests. The test is conducted using the following model

$$\Delta r_t^d = \alpha + \rho r_{t-1}^d + \sum_{j=1}^{k} \delta_j \Delta r_{t-1}^d + \varepsilon_t \quad (8)$$

where $r_{it}^d = r_{it} - \hat{\beta}_i' z_{it}$the GLS is the demeaned real interest differential at time$t$.[7] For demeaning,$z_{it} = (1)'$ and $\hat{\beta}_{0i},\ \hat{\beta}_{1i}$ are calculated by regressing $[r_1, (1-\bar{\alpha}L)r_2, \ldots, (1-\bar{\alpha}L)r_T]$ onto $[z_1, (1-\bar{\alpha}L)z_2, \ldots, (1-\bar{\alpha}L)z_T]$ where $\bar{\alpha} = 1 + \bar{c}T^{-1}$ with $\bar{c} = -7$ for a model with drift, $L$ is the lag operator, and $k$ is the number of lags chosen by minimizing the modified Akaike information criterion (MAIC). Ng and Perron (2001) show that the MAIC along with the ADF-GLS test produces tests with desirable size and power properties since it is designed to select a relatively long lag length in the presence of a moving-average root close to unity and shorter lag length when such a root is not present. The null hypothesis of a unit root is $\rho = 0$ against the alternative $\rho < 0$. The critical values for the test are provided by Elliot et al. (1996) table 1, page 825.

### *1.3.2. The KPSS Test*

To test the null hypothesis of stationarity against the alternative of non-stationarity using the KPSS test, we follow Kwiatkowski et al. (1992). They consider a series $y_t$ that can be decomposed into the sum of deter-

[7]Demeaned is the case in which a series is replaced by the residuals from the regression on a constant.

ministic trend, a random walk, and a stationary error:

$$y_t = \xi t + \nu_t + \varepsilon_t \tag{9}$$

Where $\varepsilon_t$ is a stationary process and $\nu_t$ is a random walk given by $\nu_t = \nu_{t-1} + u_t$ and $u_t \sim iid(0,\ \sigma_u^2)$. The initial value $\nu_0$ is fixed and serves as the intercept. Under these assumptions, the null hypothesis of stationarity is $\sigma_u^2 = 0$. Since $\varepsilon_t$ is assumed to be a stationary process, under the null hypothesis the series $y_t$ is trend stationary. The null hypothesis of level stationarity is tested by estimating equation (10) with an intercept only ($\xi$ is set equal to zero). The KPSS test ($LM$) statistic is given by

$$LM = T^{-2} \sum_{t=1}^{T} S_t^2 / s^2(l) \tag{10}$$

where $S_t$ is the partial sum of deviations of residuals from the sample mean, $s^2(l)$ is a consistent estimator of the long-run variance ($\sigma^2$) of the regression error, $l$ is a lag truncation parameter, and $w(s,\ l) = 1 - [s/(l+1)]$ is an optional weighting function (Bartlett weights) used to smooth the sample autocovariance function, which ensures that $s^2(l)$ is non-negative (Newey and West 1987). The null hypothesis of stationarity is accepted if the value of the KPSS test statistic is less than it is critical value.

### 1.4. Behavior of real interest differentials

It is argued that the increase in the degree of international financial integration may not lead to the equalization of real interest rates across countries under a system of floating exchange rate due to high exchange rate volatility and foreign exchange risk premium. In this section we provide the theoretical background used to analyze the behavior of RIDs over time and the impact of the transition to the floating exchange rate system on the behavior of RIDs. For this purpose, the following regression is estimated

$$\Delta r_{ijt} = \alpha_0 + \alpha_1 D + \rho_0 r_{ijt-1} + \rho_1(D)(r_{ijt-1}) + \upsilon_{ijt} \tag{11}$$

where $r_{ijt}$is real interest differential between countries $i$ and $j$ at time $t$, $D$ is a dummy variable that takes the value 1 for observations beginning in 1973:2 and 0 otherwise, and $\Delta$ is the first difference operator. $\alpha_1$ and $\rho_1$ represent the differential intercept and differential slope coefficients. For $D = 0$ yields $[\Delta r_{ijt} = \alpha_0 + \rho_0 r_{ijt-1} + \upsilon_{ijt}]$ RIDs pre-1973:2, and for $D = 1$ yields $[\Delta r_{ijt} = (\alpha_0 + \alpha_1) + (\rho_0 + \rho_1) r_{ijt-1} + \upsilon_{ijt}]$ RIDs post-1973:2. The differential intercept coefficient indicates how much the intercept coefficient post-1973:2 differs from the intercept coefficient pre-1973:2. The differential slope coefficient indicates how much the slope coefficient post-1973:2 differs from the slope coefficient pre-1973:2. The coefficient of interest is $\alpha_1$; a finding that $\alpha_1$ is statistically significantly different from zero implies significant long run differentials post-1973:2. If the transition to current float caused RIDs to widen, $\alpha_1$ should be statistically significantly different from zero and imply larger mean differentials post-1973:2 (Goldberg et al., 2003). Coefficients $\rho_0$ and $\rho_1$ are also of interest since they represent speed of convergence to RIP. A finding that $\rho_0 < 0$ is statistically significant would imply that RIDs are mean-reverting. The closer $\rho_0 + \rho_1$ to minus one, the faster the speed of convergence, which would imply nearly complete convergence to RIP within the first period. From the regression coefficients in (11), we can calculate $(\alpha_0/-\rho_0)$ the long run RIDs for countries $i$ and $j$ pre-1973:2, and $((\alpha_0+\alpha_1)/-(\rho_0+\rho_1))$ the long run RIDs for countries $i$ and $j$ post-1973:2.

### 1.5. The data

RIP is tested for the following industrialized countries: Australia, Canada, France, Germany, Italy, Japan, the Netherlands, Switzerland, the United Kingdom, and the United States. The data used in this study consist of quarterly data from 1957:1 to 2003:1 obtained from the IMF's International Financial Statistics (CD-ROM, June 2003). The data on nominal interest rates consist of long-term government bonds (line 61) and short-term money market rates and Treasury bill rates (line 60B and line 60C). If the money market rate is not available for a country, the Treasury bill rate is used to calculate RIDs as in equation (7) with the U.S. and Germany as base countries. The Consumer Price Index (CPI, line 64) is used to calculate the inflation rate as the percentage change in the logarithm of the CPI. Since the nominal interest rates obtained from the IMF' International Financial Statistics are annualized percents, the quarterly inflation rate is annualized as $\Delta Log(CPI) * 400$.[8]

## 2. RESULTS AND ANALYSIS

### 2.1. Preliminary results

As a preliminary step, we report in tables 1-4 the average RIDs for the entire period from 1957:2 to 2003:1 and for six different sub-periods, two of which are of interest. The two sub-periods are 1957:2-1973:1, which

[8]See Table A1 in appendix A for more details on the data.

pertains to the Bretton Woods system of fixed exchange rate, and 1973:2-2003:1, which corresponds to the current float. A simple hypothesis test for the entire period shows that the null hypothesis of zero average for long-term RIDs with respect to the U.S. could not be rejected for Australia, France, Italy, the Netherlands, and the U.K., and for only Canada when Germany is base country. As for short-term RIDs, the null of zero average RIDs could not be rejected for all countries when the U.S. is the base country except Canada and Switzerland, and it is rejected for Canada when Germany is the base country. Thus, the results indicate that the null hypothesis of zero average RIDs could not be rejected for five countries for long-term differentials when the U.S. is the base country, and for seven countries for short-term differentials. The evidence in favor of RIP are weaker when Germany is the base country as the null hypothesis of zero average RIDs could not be rejected for only one country for long-term differentials, and for six countries for short-term differentials.

The tables also show that the average RIDs appear to follow declining trends since 1957 indicating greater capital markets integration. Of interest is the behavior of RIDs in the Bretton Woods era and the current float. When the U.S. is the base country, the null hypothesis of zero average RIDs could not be rejected for long-term RIDs before and after 1973 for Australia and the U.K., and it could not be accepted for four countries. This implies that for six of the nine countries in the sample the behavior of long-term RIDs did not change in the current float relative to the Bretton Woods era in the sense that long-term RIDs was before and after 1973 either statistically significantly equal to zero or different from zero. As for short-term RIDs with the U.S. as the base country, the results indicate that the null could not be rejected for two countries and could not be accepted for two countries. Thus, putting all together the long-run and short-run RIDs with the U.S. as the base country, the behavior of RIDs for ten of the eighteen countries in the sample did not change pre and post1973; if it was statistically significantly equal to zero pre-1973, it had stayed so post-1973, and if it was statistically significantly different from zero pre-1973, it had stayed so post-1973. The results when Germany is the base country are different since they indicate that the behavior of RIDs for six of the eighteen countries did not change pre and post1973.[9]

Another important observation from the tables is that both long-term and short-term RIDs appear, on average, to have been lower in the 1980s

[9]The results for Germany should be interpreted cautiously due to missing data for some countries during the Bretton Woods era.

**TABLE 1.**

Long-run RIDs since 1957:1 –2003:1 (the U.S. is the base country) +

| Country | Time period | $n$ | Average | S.D. | $t$-value | $p$-value |
|---|---|---|---|---|---|---|
| AU | 1957:1-1969:4 | 51 | 0.658 | 2.153 | 2.183 | 0.0337** |
| | 1970:1-1979:4 | 40 | −1.607 | 4.484 | −2.267 | 0.0290** |
| | 1980:1-1989:4 | 40 | −0.071 | 3.415 | −0.132 | 0.8954 |
| | 1990:1-2003:1 | 53 | 1.736 | 2.865 | 4.411 | 0.0001*** |
| | 1957:1-1973:1 | 64 | 0.199 | 2.320 | 0.685 | 0.4959 |
| | 1973:2-2003:1 | 120 | 0.381 | 3.915 | 1.066 | 0.2887 |
| | 1957:1-2003:1 | 184 | 0.318 | 3.439 | 1.252 | 0.2121 |
| CA | 1957:1-1969:4 | 51 | 0.845 | 1.565 | 3.857 | 0.0003*** |
| | 1970:1-1979:4 | 40 | 0.794 | 2.235 | 2.246 | 0.0305** |
| | 1980:1-1989:4 | 40 | 0.068 | 2.413 | 0.179 | 0.8586 |
| | 1990:1-2003:1 | 53 | 1.664 | 2.106 | 5.754 | 0.0000*** |
| | 1957:1-1973:1 | 64 | 0.872 | 1.771 | 3.938 | 0.0002*** |
| | 1973:2-2003:1 | 120 | 0.917 | 2.313 | 4.342 | 0.0000*** |
| | 1957:1-2003:1 | 184 | 0.901 | 2.135 | 5.725 | 0.0000*** |
| FR | 1957:1-1969:4 | 51 | −1.472 | 4.608 | −2.281 | 0.0269** |
| | 1970:1-1979:4 | 40 | −0.167 | 1.869 | −0.567 | 0.5741 |
| | 1980:1-1989:4 | 40 | −0.553 | 2.744 | −1.274 | 0.2104 |
| | 1990:1-2003:1 | 53 | 1.300 | 1.474 | 6.428 | 0.0000*** |
| | 1957:1-1973:1 | 64 | −1.244 | 4.217 | −2.361 | 0.0213** |
| | 1973:2-2003:1 | 120 | 0.373 | 2.211 | 1.846 | 0.0674* |
| | 1957:1-2003:1 | 184 | −0.190 | 3.146 | −0.818 | 0.4142 |
| GE | 1957:1-1969:4 | 51 | 2.258 | 2.869 | 5.621 | 0.0000*** |
| | 1970:1-1979:4 | 40 | 2.641 | 3.550 | 4.705 | 0.0000*** |
| | 1980:1-1989:4 | 40 | −0.771 | 2.941 | −1.658 | 0.1053* |
| | 1990:1-2003:1 | 53 | 0.390 | 2.386 | 1.191 | 0.2390 |
| | 1957:1-1973:1 | 64 | 1.852 | 2.956 | 5.013 | 0.0000*** |
| | 1973:2-2003:1 | 120 | 0.767 | 3.262 | 2.577 | 0.0112** |
| | 1957:1-2003:1 | 184 | 1.145 | 3.193 | 4.863 | 0.0000*** |
| IT | 1957:1-1969:4 | 51 | 1.219 | 3.567 | 2.440 | 0.0183** |
| | 1970:1-1979:4 | 40 | −1.675 | 4.848 | −2.185 | 0.0350** |
| | 1980:1-1989:4 | 40 | −1.271 | 3.346 | −2.402 | 0.0212** |
| | 1990:1-2003:1 | 53 | 1.570 | 2.055 | 5.567 | 0.0000*** |
| | 1957:1-1973:1 | 64 | 0.916 | 3.455 | 2.120 | 0.0379** |
| | 1973:2-2003:1 | 120 | −0.259 | 3.866 | −0.733 | 0.4650 |
| | 1957:1-2003:1 | 184 | 0.150 | 3.761 | 0.540 | 0.5896 |

than in the 1970s and higher in the 1990s than in the 1980s regardless of the base country. The explanation for the lower RIDs in the 1980s than

**TABLE 1**—*Continued*

| Country | Time period | $n$ | Average | S.D. | $t$-value | $p$-value |
|---|---|---|---|---|---|---|
| JA | 1957:1-1969:4 | 13 | 0.412 | 4.096 | 0.363 | 0.7231 |
| | 1970:1-1979:4 | 40 | −1.339 | 5.340 | −1.568 | 0.1249 |
| | 1980:1-1989:4 | 40 | −1.410 | 2.995 | −2.977 | 0.0050*** |
| | 1990:1-2003:1 | 53 | −1.040 | 2.730 | −2.774 | 0.0077*** |
| | 1957:1-1973:1 | 26 | −0.641 | 3.815 | −0.857 | 0.3998 |
| | 1973:2-2003:1 | 120 | −1.192 | 3.825 | −3.414 | 0.0009*** |
| | 1957:1-2003:1 | 146 | −1.094 | 3.816 | −3.464 | 0.0007*** |
| NE | 1957:1-1969:4 | 51 | −0.524 | 6.007 | −0.623 | 0.5360 |
| | 1970:1-1979:4 | 40 | 0.915 | 4.061 | 1.424 | 0.1623 |
| | 1980:1-1989:4 | 40 | 0.257 | 3.433 | 0.473 | 0.6390 |
| | 1990:1-2003:1 | 53 | 0.337 | 1.858 | 1.318 | 0.1931 |
| | 1957:1-1973:1 | 64 | −0.748 | 5.565 | −1.075 | 0.2864 |
| | 1973:2-2003:1 | 120 | 0.715 | 3.033 | 2.583 | 0.0110** |
| | 1957:1-2003:1 | 184 | 0.206 | 4.139 | 0.676 | 0.5000 |
| SW | 1957:1-1969:4 | 51 | −1.057 | 2.428 | −3.108 | 0.0031*** |
| | 1970:1-1979:4 | 40 | −0.199 | 3.622 | −0.349 | 0.7291 |
| | 1980:1-1989:4 | 40 | −4.087 | 3.980 | −6.495 | 0.0000*** |
| | 1990:1-2003:1 | 53 | −1.016 | 1.680 | 4.404 | 0.0001*** |
| | 1957:1-1973:1 | 64 | −1.529 | 2.622 | −4.663 | 0.0000*** |
| | 1973:2-2003:1 | 120 | −1.512 | 3.545 | −4.671 | 0.0000*** |
| | 1957:1-2003:1 | 184 | −1.518 | 3.247 | −6.341 | 0.0000*** |
| UK | 1957:1-1969:4 | 51 | 1.03 | 3.186 | 2.309 | 0.0251** |
| | 1970:1-1979:4 | 40 | −0.737 | 5.700 | −0.818 | 0.4183 |
| | 1980:1-1989:4 | 40 | −1.152 | 3.566 | −2.044 | 0.0478** |
| | 1990:1-2003:1 | 53 | 0.574 | 3.165 | 1.321 | 0.1924 |
| | 1957:1-1973:1 | 64 | 0.578 | 3.143 | 1.494 | 0.1400 |
| | 1973:2-2003:1 | 120 | −0.252 | 4.383 | −0.629 | 0.5304 |
| | 1957:1-2003:1 | 184 | 0.040 | 4.006 | 0.136 | 0.8923 |

*, **, *** denote significance at the 10%, 5%, and 1% levels, respectively. S.D. is the standard deviation of RIDs. The null hypothesis being tested is the average of RIDs equals zero. $n$ is the sample size in each period. $^+$ Period averages, percent per annum.

**TABLE 2.**

Short-run RIDs since 1957:1 –2003:1 (the U.S. is the base country) +

| Country | Time period | $n$ | Average | S.D. | $t$-value | $p$-value |
|---|---|---|---|---|---|---|
| AU | 1957:1-1969:4 | 2 | $n.a.$ | $n.a.$ | $n.a.$ | $n.a.$ |
| | 1970:1-1979:4 | 40 | −2.6742 | 5.004 | −3.377 | 0.0017*** |
| | 1980:1-1989:4 | 40 | −0.093 | 4.281 | −0.138 | 0.8909 |
| | 1990:1-2003:1 | 53 | 2.049 | 3.399 | 4.389 | 0.0001*** |
| | 1957:1-1973:1 | 15 | −1.827 | 2.085 | −3.392 | 0.0044*** |
| | 1973:2-2003:1 | 120 | 0.185 | 4.756 | 0.425 | 0.6714 |
| | 1957:1-2003:1 | 135 | −0.039 | 4.577 | −0.099 | 0.9217 |
| CA | 1957:1-1969:4 | 51 | 0.427 | 1.695 | 1.799 | 0.0781* |
| | 1970:1-1979:4 | 40 | 0.525 | 2.769 | 1.199 | 0.2378 |
| | 1980:1-1989:4 | 40 | 1.360 | 2.519 | 3.415 | 0.0015*** |
| | 1990:1-2003:1 | 53 | 1.688 | 2.636 | 4.662 | 0.0000*** |
| | 1957:1-1973:1 | 64 | 0.248 | 1.982 | 1.003 | 0.3198 |
| | 1973:2-2003:1 | 120 | 1.423 | 2.596 | 6.002 | 0.0000*** |
| | 1957:1-2003:1 | 184 | 1.014 | 2.460 | 5.593 | 0.0000*** |
| FR | 1957:1-1969:4 | 51 | −1.361 | 4.551 | −2.136 | 0.0376** |
| | 1970:1-1979:4 | 40 | −0.384 | 2.158 | −1.127 | 0.2667 |
| | 1980:1-1989:4 | 40 | −0.803 | 3.026 | −1.679 | 0.1012* |
| | 1990:1-2003:1 | 37 | 2.575 | 3.329 | 4.705 | 0.0000*** |
| | 1957:1-1973:1 | 64 | −1.174 | 4.214 | −2.229 | 0.0293** |
| | 1973:2-2003:1 | 104 | 0.515 | 3.284 | 1.598 | 0.1130 |
| | 1957:1-2003:1 | 168 | −0.129 | 3.745 | −0.446 | 0.6563 |
| GE | 1957:1-1969:4 | 51 | −0.148 | 2.741 | −0.386 | 0.7011 |
| | 1970:1-1979:4 | 40 | 1.073 | 3.047 | 2.227 | 0.0318** |
| | 1980:1-1989:4 | 40 | −1.274 | 2.741 | −2.939 | 0.0055*** |
| | 1990:1-2003:1 | 53 | 1.034 | 2.892 | 2.602 | 0.0120** |
| | 1957:1-1973:1 | 64 | −0.196 | 2.827 | −0.554 | 0.5514 |
| | 1973:2-2003:1 | 120 | 0.431 | 3.049 | 1.548 | 0.1242 |
| | 1957:1-2003:1 | 184 | 0.213 | 2.981 | 0.969 | 0.3339 |
| IT | 1957:1-1969:4 | 0 | $n.a.$ | $n.a.$ | $n.a.$ | $n.a.$ |
| | 1970:1-1979:4 | 36 | −2.046 | 4.201 | −2.922 | 0.0061*** |
| | 1980:1-1989:4 | 40 | 0.573 | 4.136 | 0.876 | 0.3863 |
| | 1990:1-2003:1 | 53 | 2.286 | 3.069 | 5.423 | 0.0000*** |
| | 1957:1-1973:1 | 9 | −1.897 | 2.949 | −1.929 | 0.0898* |
| | 1973:2-2003:1 | 120 | 0.729 | 4.150 | 1.925 | 0.0567* |
| | 1957:1-2003:1 | 129 | 0.546 | 4.124 | 1.504 | 0.1352 |

in the 1970s follows from the fact that most countries either removed or reduced capital controls in the 1970s; for example, Germany removed cap-

**TABLE 2**—*Continued*

| Country | Time period | $n$ | Average | S.D. | $t$-value | $p$-value |
|---|---|---|---|---|---|---|
| JA | 1957:1-1969:4 | 51 | 2.707 | 5.151 | 3.753 | 0.0005*** |
| | 1970:1-1979:4 | 40 | −1.348 | 5.430 | −1.570 | 0.1244 |
| | 1980:1-1989:4 | 40 | −1.173 | 3.121 | −2.378 | 0.0224** |
| | 1990:1-2003:1 | 53 | −0.515 | 3.290 | −1.139 | 0.2600 |
| | 1957:1-1973:1 | 64 | 1.899 | 5.132 | 2.961 | 0.0043*** |
| | 1973:2-2003:1 | 120 | −0.930 | 4.038 | −2.524 | 0.0129** |
| | 1957:1-2003:1 | 184 | 0.054 | 4.637 | 0.158 | 0.8747 |
| NE | 1957:1-1969:4 | 40 | −1.032 | 5.902 | −1.106 | 0.2757 |
| | 1970:1-1979:4 | 40 | −0.834 | 4.771 | −1.105 | 0.2758 |
| | 1980:1-1989:4 | 40 | −0.49 | 3.315 | −0.876 | 0.3867 |
| | 1990:1-2003:1 | 36 | 1.146 | 3.334 | 2.062 | 0.0467** |
| | 1957:1-1973:1 | 53 | −1.593 | 5.557 | −2.087 | 0.0418** |
| | 1973:2-2003:1 | 103 | 0.317 | 3.756 | 0.858 | 0.3931 |
| | 1957:1-2003:1 | 156 | −0.332 | 4.524 | −0.915 | 0.3614 |
| SW | 1957:1-1969:4 | 0 | *n.a.* | *n.a.* | *n.a.* | *n.a.* |
| | 1970:1-1979:4 | 17 | 0.053 | 2.615 | 0.083 | 0.9350 |
| | 1980:1-1989:4 | 40 | −5.162 | 4.535 | −7.199 | 0.0000*** |
| | 1990:1-2003:1 | 53 | −0.306 | 2.311 | −0.965 | 0.3392 |
| | 1957:1-1973:1 | 0 | *n.a.* | *n.a.* | *n.a.* | *n.a.* |
| | 1973:2-2003:1 | 110 | −2.017 | 4.078 | −5.186 | 0.0000*** |
| | 1957:1-2003:1 | 110 | −2.017 | 4.078 | −5.186 | 0.0000*** |
| UK | 1957:1-1969:4 | 51 | 0.629 | 3.234 | 1.389 | 0.1708 |
| | 1970:1-1979:4 | 40 | −2.572 | 5.485 | −2.966 | 0.0051*** |
| | 1980:1-1989:4 | 40 | 0.715 | 3.999 | 1.130 | 0.2654 |
| | 1990:1-2003:1 | 53 | 1.956 | 3.300 | 4.314 | 0.0001*** |
| | 1957:1-1973:1 | 64 | 0.005 | 3.297 | 0.011 | 0.9913 |
| | 1973:2-2003:1 | 120 | 0.509 | 4.744 | 1.177 | 0.2416 |
| | 1957:1-2003:1 | 184 | 0.334 | 4.294 | 1.055 | 0.2927 |

*, **, *** denote significance at the 10%, 5%, and 1% levels, respectively. S.D. is the standard deviation of RIDs. The null hypothesis being tested is the average of RIDs equals zero. $n$ is the sample size in each period. $^{+}$ Period averages, percent per annum.

ital controls in 1973-1974, Japan in 1979-1980, and the United Kingdom in 1979. The higher RIDs in the 1990s than in the 1980s might be due to country risk and/or currency risk. To see this, RIP can be decomposed into two components: covered interest differentials, which represents country or political risk because it captures all barriers to the international financial markets integration, such as transaction costs, information costs, tax laws, default risk, and risk of future capital controls (Frankel, 1992). The second

**TABLE 3.**

Long-run RIDs since 1957:1 –2003:1 (Germany is the base country) +

| Country | Time period | $n$ | Average | S.D. | $t$-value | $p$-value |
|---|---|---|---|---|---|---|
| AU | 1957:1-1969:4 | 51 | −1.600 | 3.259 | −3.506 | 0.0010*** |
| | 1970:1-1979:4 | 40 | −4.284 | 5.431 | −4.947 | 0.0000*** |
| | 1980:1-1989:4 | 40 | 0.699 | 3.353 | 1.320 | 0.1946 |
| | 1990:1-2003:1 | 53 | 1.346 | 3.183 | 3.078 | 0.0033*** |
| | 1957:1-1973:1 | 64 | −1.654 | 3.265 | −4.052 | 0.0001*** |
| | 1973:2-2003:1 | 120 | −0.387 | 4.807 | −0.881 | 0.3802 |
| | 1957:1-2003:1 | 184 | −0.827 | 4.366 | −2.570 | 0.0110** |
| CA | 1957:1-1969:4 | 51 | −1.413 | 3.247 | −3.107 | 0.0031*** |
| | 1970:1-1979:4 | 40 | −1.847 | 3.643 | −3.206 | 0.0027*** |
| | 1980:1-1989:4 | 40 | 0.840 | 2.217 | 2.396 | 0.0215** |
| | 1990:1-2003:1 | 53 | 1.274 | 3.574 | 2.594 | 0.0123** |
| | 1957:1-1973:1 | 64 | −0.983 | 3.276 | −2.394 | 0.0197** |
| | 1973:2-2003:1 | 120 | 0.149 | 3.565 | 0.458 | 0.6476 |
| | 1957:1-2003:1 | 184 | −0.244 | 3.500 | −0.944 | 0.3462 |
| FR | 1957:1-1969:4 | 51 | −3.729 | 5.143 | −5.179 | 0.0000*** |
| | 1970:1-1979:4 | 40 | −2.808 | 3.397 | −5.229 | 0.0000*** |
| | 1980:1-1989:4 | 40 | 0.219 | 2.420 | 0.572 | 0.5709 |
| | 1990:1-2003:1 | 53 | 0.910 | 2.326 | 2.848 | 0.0063*** |
| | 1957:1-1973:1 | 64 | −3.097 | 4.914 | −5.042 | 0.0000*** |
| | 1973:2-2003:1 | 120 | −0.395 | 3.175 | −1.362 | 0.1757 |
| | 1957:1-2003:1 | 184 | −1.335 | 4.066 | −4.452 | 0.0000*** |
| IT | 1957:1-1969:4 | 51 | −1.039 | 2.797 | −2.654 | 0.0106** |
| | 1970:1-1979:4 | 40 | −4.316 | 5.967 | −4.575 | 0.0000*** |
| | 1980:1-1989:4 | 40 | −0.499 | 2.964 | −1.066 | 0.2929 |
| | 1990:1-2003:1 | 53 | 1.180 | 3.147 | 2.730 | 0.0086*** |
| | 1957:1-1973:1 | 64 | −0.937 | 2.856 | −2.623 | 0.0109** |
| | 1973:2-2003:1 | 120 | −1.026 | 4.872 | −2.307 | 0.0228** |
| | 1957:1-2003:1 | 184 | −0.995 | 4.271 | −3.160 | 0.0018*** |

component is currency risk, which represents exchange rate risk premium and expected real depreciation. The 1990s have experienced both financial and political events that have had a great impact on the world economy. The Iraqi invasion of Kuwait in 1990 and then the first Gulf war in 1991, the breakup of the Soviet Union in 1991, the western European exchange rate mechanism crisis in 1992, the Mexican crisis of 1994-1995, the East Asian financial crisis of 1997-1998, the Russian crisis in 1998, and the Brazilian crisis of 1998-1999. These events have caused both political and financial unrest in the world economy, which, I believe, caused both country and cur-

**TABLE 3**—*Continued*

| Country | Time period | $n$ | Average | S.D. | $t$-value | $p$-value |
|---|---|---|---|---|---|---|
| JA | 1957:1-1969:4 | 13 | −3.245 | 4.185 | −2.795 | 0.0165** |
| | 1970:1-1979:4 | 40 | −3.980 | 6.211 | −4.052 | 0.0002*** |
| | 1980:1-1989:4 | 40 | −0.639 | 2.937 | −1.375 | 0.1768 |
| | 1990:1-2003:1 | 53 | −1.431 | 3.479 | −2.994 | 0.0042*** |
| | 1957:1-1973:1 | 26 | −2.600 | 4.054 | −3.269 | 0.0031*** |
| | 1973:2-2003:1 | 120 | −1.960 | 4.609 | −4.657 | 0.0000*** |
| | 1957:1-2003:1 | 146 | −2.074 | 4.509 | −5.557 | 0.0000*** |
| NE | 1957:1-1969:4 | 51 | −2.782 | 4.927 | −4.033 | 0.0002*** |
| | 1970:1-1979:4 | 40 | −1.726 | 3.493 | −3.126 | 0.0033*** |
| | 1980:1-1989:4 | 40 | 1.028 | 2.886 | 2.252 | 0.0300** |
| | 1990:1-2003:1 | 53 | −0.054 | 2.401 | −0.163 | 0.8710 |
| | 1957:1-1973:1 | 64 | −2.600 | 4.634 | −4.489 | 0.0000*** |
| | 1973:2-2003:1 | 120 | −0.052 | 3.019 | −0.190 | 0.8497 |
| | 1957:1-2003:1 | 184 | −0.939 | 3.847 | −3.309 | 0.0011*** |
| SW | 1957:1-1969:4 | 51 | −3.315 | 2.876 | −8.232 | 0.0000*** |
| | 1970:1-1979:4 | 40 | −2.841 | 3.671 | −4.894 | 0.0000*** |
| | 1980:1-1989:4 | 40 | −3.316 | 2.533 | −8.280 | 0.0000*** |
| | 1990:1-2003:1 | 53 | −1.407 | 2.923 | −3.504 | 0.0010*** |
| | 1957:1-1973:1 | 64 | −3.381 | 2.861 | −9.453 | 0.0000*** |
| | 1973:2-2003:1 | 120 | −2.279 | 3.163 | −7.893 | 0.0000*** |
| | 1957:1-2003:1 | 184 | −2.662 | 3.101 | −11.655 | 0.0000*** |
| UK | 1957:1-1969:4 | 51 | −1.228 | 2.779 | −3.157 | 0.0027*** |
| | 1970:1-1979:4 | 40 | −3.378 | 5.329 | −4.009 | 0.0003*** |
| | 1980:1-1989:4 | 40 | −0.381 | 3.832 | −0.629 | 0.5331 |
| | 1990:1-2003:1 | 53 | 0.184 | 4.127 | 0.324 | 0.7471 |
| | 1957:1-1973:1 | 64 | −1.265 | 2.811 | −3.601 | 0.0006*** |
| | 1973:2-2003:1 | 120 | −1.019 | 4.823 | −2.315 | 0.0223** |
| | 1957:1-2003:1 | 184 | −1.105 | 4.226 | −3.546 | 0.0005*** |

*, **, *** denote significance at the 10%, 5%, and 1% levels, respectively. S.D. is the standard deviation of RIDs. The null hypothesis being tested is the average of RIDs equals zero. $n$ is the sample size in each period. $^+$ Period averages, percent per annum.

rency risks to increase in the 1990s, thus causing real interest differentials to widen in the 1990s relative to the 1980s.[10]

[10]It is not the objective of this paper to decompose RIDs into country risk and currency risk. A lot of papers have done this decomposition; see, for example, Frankel (1991) and Chin and Frankel (1994).

**TABLE 4.**

Short-run RIDs since 1957:1 –2003:1 (Germany is the base country) +

| Country | Time period | $n$ | Average | S.D. | $t$-value | $p$-value |
|---|---|---|---|---|---|---|
| AU | 1957:1-1969:4 | 2 | *n.a.* | *n.a.* | *n.a.* | *n.a.* |
| | 1970:1-1979:4 | 40 | −3.745 | 6.061 | −3.908 | 0.0004*** |
| | 1980:1-1989:4 | 40 | 1.181 | 4.144 | 1.802 | 0.0793* |
| | 1990:1-2003:1 | 53 | 1.016 | 3.082 | 2.399 | 0.0200** |
| | 1957:1-1973:1 | 15 | −1.791 | 3.642 | −1.905 | 0.0775* |
| | 1973:2-2003:1 | 120 | −0.246 | 5.068 | −0.532 | 0.5956 |
| | 1957:1-2003:1 | 135 | −0.418 | 4.943 | −0.982 | 0.3277 |
| CA | 1957:1-1969:4 | 0 | *n.a.* | *n.a.* | *n.a.* | *n.a.* |
| | 1970:1-1979:4 | 18 | −0.398 | 3.369 | −0.502 | 0.6224 |
| | 1980:1-1989:4 | 40 | 1.926 | 2.396 | 5.083 | 0.0000*** |
| | 1990:1-2003:1 | 53 | 0.669 | 3.348 | 1.454 | 0.1519 |
| | 1957:1-1973:1 | 0 | *n.a.* | *n.a.* | *n.a.* | *n.a.* |
| | 1973:2-2003:1 | 111 | 0.949 | 3.126 | 3.198 | 0.0018*** |
| | 1957:1-2003:1 | 111 | 0.949 | 3.126 | 3.198 | 0.0018*** |
| FR | 1957:1-1969:4 | 51 | −1.213 | 4.866 | −1.780 | 0.0811* |
| | 1970:1-1979:4 | 40 | −1.457 | 3.215 | −2.867 | 0.0066*** |
| | 1980:1-1989:4 | 40 | 0.471 | 2.916 | 1.021 | 0.3134 |
| | 1990:1-2003:1 | 37 | 1.299 | 2.694 | 2.935 | 0.0058*** |
| | 1957:1-1973:1 | 64 | −0.979 | 4.548 | −1.721 | 0.0901* |
| | 1973:2-2003:1 | 104 | 0.090 | 3.186 | 0.289 | 0.7731 |
| | 1957:1-2003:1 | 168 | −0.317 | 3.786 | −1.085 | 0.2796 |
| IT | 1957:1-1969:4 | 0 | *n.a.* | *n.a.* | *n.a.* | *n.a.* |
| | 1970:1-1979:4 | 36 | -2.897 | 4.920 | −3.533 | 0.0012*** |
| | 1980:1-1989:4 | 40 | 1.847 | 3.795 | 3.078 | 0.0038*** |
| | 1990:1-2003:1 | 53 | 1.252 | 2.835 | 3.215 | 0.0022*** |
| | 1957:1-1973:1 | 9 | 0.017 | 3.414 | 0.014 | 0.9886 |
| | 1973:2-2003:1 | 120 | 0.298 | 4.343 | 0.752 | 0.4534 |
| | 1957:1-2003:1 | 129 | 0.279 | 4.275 | 0.740 | 0.4605 |

The next section presents the results of applying the ADF-GLS unit root test and the KPSS stationarity test on long-term and short-term RIDs with the U.S. and Germany as base countries.

## 2.2. Unit Root Tests

The results of applying unit root tests on long-term and short-term RIDs are reported in tables 5 and 6. We examine the behavior of RIDs for the entire period from 1957:1 to 2003:1 and for two important sub-periods: the Bretton Woods era from 1957:1 to 1973:1 and the current float from 1973:2

**TABLE 4**—*Continued*

| Country | Time period | $n$ | Average | S.D. | $t$-value | $p$-value |
|---|---|---|---|---|---|---|
| JA | 1957:1-1969:4 | 51 | 2.855 | 4.785 | 4.261 | 0.0001*** |
| | 1970:1-1979:4 | 40 | −2.421 | 6.361 | −2.407 | 0.0209** |
| | 1980:1-1989:4 | 40 | 0.101 | 2.980 | 0.214 | 0.8315 |
| | 1990:1-2003:1 | 53 | −1.548 | 3.279 | −3.437 | 0.0012*** |
| | 1957:1-1973:1 | 64 | 2.096 | 4.854 | 3.454 | 0.0010*** |
| | 1973:2-2003:1 | 120 | −1.361 | 4.508 | −3.308 | 0.0012*** |
| | 1957:1-2003:1 | 184 | −0.159 | 4.904 | −0.439 | 0.6608 |
| NE | 1957:1-1969:4 | 40 | −0.640 | 4.594 | −0.881 | 0.3834 |
| | 1970:1-1979:4 | 40 | −1.906 | 4.415 | −2.731 | 0.0094*** |
| | 1980:1-1989:4 | 40 | 0.815 | 2.906 | 1.774 | 0.0838* |
| | 1990:1-2003:1 | 36 | −0.173 | 2.647 | −0.392 | 0.6972 |
| | 1957:1-1973:1 | 53 | −1.204 | 4.349 | −2.015 | 0.0491** |
| | 1973:2-2003:1 | 103 | −0.114 | 3.550 | −0.325 | 0.7460 |
| | 1957:1-2003:1 | 156 | −0.484 | 3.861 | −1.565 | 0.1195 |
| SW | 1957:1-1969:4 | 0 | *n.a.* | *n.a.* | *n.a.* | *n.a.* |
| | 1970:1-1979:4 | 0 | *n.a.* | *n.a.* | *n.a.* | *n.a.* |
| | 1980:1-1989:4 | 40 | −2.075 | 2.832 | −4.634 | 0.0000*** |
| | 1990:1-2003:1 | 53 | −1.007 | 2.628 | −2.791 | 0.0073*** |
| | 1957:1-1973:1 | 0 | *n.a.* | *n.a.* | *n.a.* | *n.a.* |
| | 1973:2-2003:1 | 93 | −1.467 | 2.754 | −5.135 | 0.0000*** |
| | 1957:1-2003:1 | 93 | −1.467 | 2.754 | −5.135 | 0.0000*** |
| UK | 1957:1-1969:4 | 0 | *n.a.* | *n.a.* | *n.a.* | *n.a.* |
| | 1970:1-1979:4 | 18 | −3.814 | 4.089 | −3.957 | 0.0010*** |
| | 1980:1-1989:4 | 40 | 1.279 | 3.897 | 2.077 | 0.0444** |
| | 1990:1-2003:1 | 53 | 0.937 | 3.634 | 1.877 | 0.0661* |
| | 1957:1-1973:1 | 0 | *n.a.* | *n.a.* | *n.a.* | *n.a.* |
| | 1973:2-2003:1 | 111 | 0.290 | 4.186 | 0.730 | 0.4669 |
| | 1957:1-2003:1 | 111 | 0.290 | 4.186 | 0.730 | 0.4669 |

*, **, *** denote significance at the 10%, 5%, and 1% levels, respectively. S.D. is the standard deviation of RIDs. The null hypothesis being tested is the average of RIDs equals zero. $n$ is the sample size in each period. $^{+}$ Period averages, percent per annum.

to 2003:1.[11] As a benchmark, the standard ADF unit test is applied on RIDs for the entire period and for the two sub-periods. The number of lags in the standard ADF test is selected using Schwartz Information Criterion (SIC). The results indicate that the null hypothesis of a unit root for both long-term and short-term RIDs can not be accepted for the entire period at the five percent significance level or better for all countries and regardless of the base country, except for Australia, Italy, and Switzerland's short-term RIDs when the U.S. is the base country, and for Australia's short-term RIDs when Germany is the base country. The results for the two sub-periods are slightly different and provide less support for RIP over short spans of data.

The results of applying the ADF-GLS test for the entire sample indicate that the null hypothesis of a unit root could not be accepted at the 5 percent significance level or better for long-term RIDs when the U.S. is the base country for four countries: Australia, Canada, France, and the Netherlands. The null could not be accepted at the 10 percent significance level for three countries: Japan, Switzerland, and the United Kingdom, and no evidence of stationarity for Germany and Italy. The null could not be accepted at the 5 percent significance level or better when Germany is the base country for five countries: Canada, France, Japan, Switzerland, and the U.K., and no evidence of stationarity for Australia, Italy, and the Netherlands. Thus, at the 5 percent significance level or better the results for long-term RIDs do not seem to be sensitive to the choice of the base country.

The results for the two sub-periods indicate that the null of a unit root could not be accepted at the 5 percent significance level or better for long-term RIDs when the U.S. is the base country for the current float for five countries: Australia, Canada, Japan, Switzerland, and the Netherlands, and for three countries for the Bretton Woods era: Australia, France, and Japan. The null could not be rejected before and after 1973 for two countries: Germany and Italy. Overall, the results indicate that the behavior of long-term RIDs when the U.S. is the base country did not change between the Bretton Woods era and the current float for five countries: Australia, Germany, Italy, Japan, and the Netherlands. The behavior did not change in the sense that stationarity or nonstationarity of long-term RIDs was maintained before and after 1973. When Germany is the base country the null could not be accepted at the 5 percent significance level or better for long-term RIDs for the current float for Canada and Switzerland,

[11] The Bretton Woods system extends from 1944 to 1973.

**TABLE 5.**

Unit root tests of long-run real interest differentials

| | | U.S. is the base country | | | | Germany is the base country | | |
|---|---|---|---|---|---|---|---|---|
| Country | Time period | $n$ | ADF | ADF-GLS | KPSS | ADF | ADF-GLS | KPSS |
| AU | 1957:1-1973:1 | 64 | $-3.91(0)^{***}$ | $-2.75(2)^{***}$ | $0.25(5)^{a}$ | $-2.73(3)^{*}$ | $-2.49(3)^{**}$ | $0.20(0)^{a}$ |
| | 1973:2-2003:1 | 120 | $-2.62(3)^{*}$ | $-2.50(3)^{**}$ | $0.43(8)^{b}$ | $-2.20(3)$ | $-1.68(7)^{*}$ | $0.69(8)^{c}$ |
| | 1957:1-2003:1 | 184 | $-3.53(3)^{***}$ | $-2.14(12)^{**}$ | $0.26(9)^{a}$ | $-2.92(3)^{**}$ | $-1.53(11)$ | $0.62(10)^{c}$ |
| CA | 1957:1-1973:1 | 64 | $-2.03(4)$ | $-1.55(3)$ | $0.09(3)^{a}$ | $-2.71(4)^{*}$ | $-1.48(3)$ | $0.19(0)^{a}$ |
| | 1973:2-2003:1 | 120 | $-6.50(0)^{***}$ | $-2.71(5)^{***}$ | $0.26(7)^{a}$ | $-2.66(3)^{*}$ | $-2.66(3)^{***}$ | $0.66(8)^{c}$ |
| | 1957:1-2003:1 | 184 | $-8.78(0)^{***}$ | $-2.88(7)^{***}$ | $0.15(8)^{a}$ | $-3.21(3)^{***}$ | $-2.07(6)^{**}$ | $0.67(10)^{c}$ |
| FR | 1957:1-1973:1 | 64 | $-3.35(7)^{**}$ | $-3.03(3)^{***}$ | $0.66(1)^{c}$ | $-3.57(7)^{***}$ | $-1.88(8)^{*}$ | $0.54(3)^{c}$ |
| | 1973:2-2003:1 | 120 | $-3.48(2)^{**}$ | $-1.52(5)$ | $0.41(8)^{a}$ | $-2.28(3)$ | $-1.27(11)$ | $0.90(8)$ |
| | 1957:1-2003:1 | 184 | $-3.14(8)^{**}$ | $-1.96(5)^{**}$ | $0.76(8)$ | $-3.53(6)^{***}$ | $-2.51(6)^{**}$ | $1.20(9)$ |
| GE | 1957:1-1973:1 | 64 | $-1.74(3)$ | $-0.79(3)$ | $0.19(3)^{a}$ | *n.a.* | *n.a.* | *n.a.* |
| | 1973:2-2003:1 | 120 | $-3.23(4)^{**}$ | $-1.40(11)$ | $0.35(8)^{b}$ | *n.a.* | *n.a.* | *n.a.* |
| | 1957:1-2003:1 | 184 | $-3.83(4)^{***}$ | $-1.28(11)$ | $0.48(10)^{c}$ | *n.a.* | *n.a.* | *n.a.* |
| IT | 1957:1-1973:1 | 64 | $-1.64(2)$ | $-0.10(3)$ | $0.14(5)^{a}$ | $-6.76(0)^{***}$ | $-0.30(8)$ | $0.12(3)^{a}$ |
| | 1973:2-2003:1 | 120 | $-2.35(9)$ | $-1.48(11)$ | $0.68(8)^{c}$ | $-3.71(1)^{***}$ | $-1.92(7)^{*}$ | $0.81(8)$ |
| | 1957:1-2003:1 | 184 | $-3.11(9)^{**}$ | $-0.81(9)$ | $0.17(9)^{a}$ | $-5.19(1)^{***}$ | $-1.40(7)$ | $0.44(9)^{b}$ |
| JA | 1957:1-1973:1 | 26 | $-5.83(0)^{***}$ | $-2.80(2)^{***}$ | $0.50(25)^{c}$ | $-6.40(0)^{***}$ | $-1.66(3)^{*}$ | $0.24(8)^{a}$ |
| | 1973:2-2003:1 | 120 | $-3.39(4)^{**}$ | $-2.34(11)^{**}$ | $0.07(8)^{a}$ | $-3.87(4)^{***}$ | $-0.88(9)$ | $0.32(8)^{a}$ |
| | 1957:1-2003:1 | 146 | $-3.61(4)^{***}$ | $-1.92(12)^{*}$ | $0.05(9)^{a}$ | $-4.36(4)^{***}$ | $-2.33(11)^{**}$ | $0.34(9)^{b}$ |
| NE | 1957:1-1973:1 | 64 | $-7.45(1)^{***}$ | $-1.80(7)^{*}$ | $0.09(6)^{a}$ | $-7.26(1)^{***}$ | $-1.17(10)$ | $0.08(8)^{a}$ |
| | 1973:2-2003:1 | 120 | $-3.69(4)^{**}$ | $-1.25(7)$ | $0.19(8)^{a}$ | $-2.74(3)^{*}$ | $-0.54(7)$ | $0.26(8)^{a}$ |
| | 1957:1-2003:1 | 184 | $-3.07(7)^{**}$ | $-4.18(3)^{***}$ | $0.13(8)^{a}$ | $-4.21(3)^{***}$ | $-0.88(7)$ | $0.94(9)$ |
| SW | 1957:1-1973:1 | 64 | $-1.96(3)$ | $-1.01(3)$ | $0.19(5)^{a}$ | $-8.60(1)^{***}$ | $-7.11(0)^{***}$ | $0.23(15)^{a}$ |
| | 1973:2-2003:1 | 120 | $-2.30(3)$ | $-2.09(3)^{**}$ | $0.19(8)^{a}$ | $-2.84(3)^{*}$ | $-2.55(3)^{**}$ | $0.43(8)^{b}$ |
| | 1957:1-2003:1 | 184 | $-2.97(3)^{**}$ | $-1.82(11)^{*}$ | $0.10(10)^{a}$ | $-3.63(3)^{***}$ | $-3.59(3)^{***}$ | $0.56(9)^{c}$ |
| UK | 1957:1-1973:1 | 64 | $-2.41(4)$ | $-0.53(9)$ | $0.19(1)^{a}$ | $-3.97(4)^{***}$ | $-3.02(3)^{***}$ | $0.13(13)^{a}$ |
| | 1973:2-2003:1 | 120 | $-4.60(4)^{***}$ | $-3.23(3)^{***}$ | $0.20(7)^{a}$ | $-3.65(4)^{***}$ | $-1.57(11)$ | $0.50(8)^{c}$ |
| | 1957:1-2003:1 | 184 | $-5.28(4)^{***}$ | $-1.74(11)^{*}$ | $0.12(9)^{a}$ | $-4.66(4)^{***}$ | $-3.50(3)^{**}$ | $0.37(9)^{b}$ |

Notes: *, **, *** denote significance at the 10%, 5%, and 1% level, respectively. The 10%, 5%, and 1% significance levels are −2.58, −2.88, and −3.47 for the ADF test, −1.62, −1.94, and −2.58 for the ADF-GLS test, 0.35, 0.46, and 0.74 for the KPSS test. [a], [b], and [c] denote acceptance of the null of stationarity in the KPSS at the 10%, 5%, and 1% level, respectively.

and at the 10 percent significance level for Australia and Italy. It could not be accepted for the Bretton Woods era at the 5 percent significance level or better for Australia, Switzerland, and the U.K. Thus, at the 5 percent significance level or better the results indicate that that the behavior of long-term RIDs when Germany is the base country did not change

**TABLE 6.**

Unit root tests of short-run real interest differentials

| | | U.S. is the base country | | | | Germany is the base country | | | |
|---|---|---|---|---|---|---|---|---|---|
| Country | Time period | $n$ | ADF | ADF-GLS | KPSS | $n$ | ADF | ADF-GLS | KPSS |
| AU | 1957:1-1973:1 | 15 | *n.a.* | *n.a.* | *n.a.* | 15 | *n.a.* | *n.a.* | *n.a.* |
| | 1973:2-2003:1 | 120 | −2.20(3) | −2.23(3)** | 0.61(8) [c] | 120 | −2.56(3) | −0.92(11) | 0.66(8) [c] |
| | 1957:1-2003:1 | 135 | −2.26(3) | −2.20(3)** | 0.69(3) [c] | 135 | −2.76(3)* | −1.15(11) | 0.73(8) |
| CA | 1957:1-1973:1 | 64 | −1.52(3) | −1.01(3) | 0.19(3) [a] | 0 | *n.a.* | *n.a.* | *n.a.* |
| | 1973:2-2003:1 | 120 | −6.11(0)*** | −1.67(5)* | 0.19(7) [a] | 111 | −8.54(0)*** | −0.93(5) | 0.26(3) [a] |
| | 1957:1-2003:1 | 184 | −7.67(0)*** | −2.49(7)** | 0.33(9) [a] | 111 | −8.54(0)*** | −0.93(5) | 0.26(3) [a] |
| FR | 1957:1-1973:1 | 64 | −2.85(7)* | −2.71(3)*** | 0.46(6) [c] | 64 | −3.81(7)*** | −1.75(6)* | 0.70(0) [c] |
| | 1973:2-2003:1 | 104 | −2.28(2) | −1.63(3)* | 0.40(8) [b] | 104 | −2.24(3) | −2.26(3)** | 0.71(8) [c] |
| | 1957:1-2003:1 | 168 | −4.07(3)*** | −2.37(3)** | 0.56(9) [c] | 168 | −5.17(3)*** | −1.71(6)* | 0.67(9) [c] |
| GE | 1957:1-1973:1 | 64 | −3.08(2)** | −1.43(3) | 0.14(1) [a] | *n.a.* | *n.a.* | *n.a.* | *n.a.* |
| | 1973:2-2003:1 | 120 | −3.13(4)** | −1.81(3)* | 0.11(8) [a] | *n.a.* | *n.a.* | *n.a.* | *n.a.* |
| | 1957:1-2003:1 | 184 | −3.94(4)*** | −1.75(11)* | 0.07(9) [a] | *n.a.* | *n.a.* | *n.a.* | *n.a.* |
| IT | 1957:1-1973:1 | 9 | *n.a.* | *n.a.* | *n.a.* | 9 | *n.a.* | *n.a.* | *n.a.* |
| | 1973:2-2003:1 | 120 | −2.23(3) | −1.94(11)* | 0.50(9) [c] | 120 | −3.48(1)** | −1.48(11) | 0.55(8) [c] |
| | 1957:1-2003:1 | 129 | −1.98(3) | −1.94(11)* | 0.54(9) [c] | 129 | −3.73(1)*** | −1.48(11) | 0.47(9) [c] |
| JA | 1957:1-1973:1 | 64 | −3.43(3)** | −1.81(4)* | 0.82(5) | 64 | −3.60(3)*** | −1.36(6) | 0.84(5) |
| | 1973:2-2003:1 | 120 | −4.26(4)*** | −2.05(11)** | 0.11(7) [a] | 120 | −5.13(4)*** | −2.04(11)** | 0.20(7) [a] |
| | 1957:1-2003:1 | 184 | −5.38(4)*** | −0.61(11) | 0.49(9) [c] | 184 | −5.65(4)*** | −0.73(11) | 0.61(9) [c] |
| NE | 1957:1-1973:1 | 53 | −2.22(3) | −1.07(7) | 0.18(1) [a] | 53 | −6.30(1)*** | −0.55(7) | 0.33(8) [a] |
| | 1973:2-2003:1 | 103 | −3.88(1)*** | −1.03(3) | 0.12(8) [a] | 103 | −3.04(3)** | −0.79(7) | 0.32(7) [a] |
| | 1957:1-2003:1 | 156 | −3.64(4)*** | −2.67(7)*** | 0.26(9) [a] | 156 | −3.78(3)*** | −2.12(7)** | 0.35(9) [b] |
| SW | 1957:1-1973:1 | 0 | *n.a.* | *n.a.* | *n.a.* | 0 | *n.a.* | *n.a.* | *n.a.* |
| | 1973:2-2003:1 | 110 | −1.77(3) | −1.77(3)* | 0.27(8) [a] | 93 | −8.73(0)*** | −1.71(11)* | 0.57(1) [c] |
| | 1957:1-2003:1 | 110 | −1.77(3) | −1.77(3)* | 0.27(8) [a] | 93 | −8.73(0)*** | −1.71(11)* | 0.57(1) [c] |
| UK | 1957:1-1973:1 | 64 | −2.22(3) | −1.61(3) | 0.44(2) [b] | 0 | *n.a.* | *n.a.* | *n.a.* |
| | 1973:2-2003:1 | 120 | −3.29(4)** | −1.26(11) | 0.64(8) [c] | 111 | −3.07(3)** | −0.23(7) | 0.58(8) [c] |
| | 1957:1-2003:1 | 184 | −3.90(4)*** | −2.17(8)** | 0.42(10) [b] | 111 | −3.07(3)** | −0.23(7) | 0.58(8) [c] |

Notes: *, **, *** denote significance at the 10%, 5%, and 1% level, respectively. The 10%, 5%, and 1% significance levels are −2.58, −2.88, and −3.47 for the ADF test, −1.62, −1.94, and −2.58 for the ADF-GLS test, 0.35, 0.46, and 0.74 for the KPSS test. [a], [b], and [c] denote acceptance of the null of stationarity in the KPSS at the 10%, 5%, and 1% level, respectively.

between the Bretton Woods era and the current float for five countries: France, Italy, Japan, the Netherlands, and Switzerland.

As for short-term RIDs, the results should be interpreted cautiously because some data are missing for some sub-periods, especially during the Bretton Woods era. The results indicate that the null of a unit root for the entire period could not be accepted at the 5 percent significance level or better for five countries (Australia, Canada, France, the Netherlands, and the U.K.) when the U.S. is the base country, and for only the Netherlands when Germany is the base country. The evidence for short-term RIDs are more supportive when the U.S. is the base country since the null of a unit root could not be accepted at the 5 percent significance level or better for five countries when the U.S. is the base country, and for only one country when Germany is the base country.

At the 5 percent significance level or better the results for the two sub-periods indicate that the behavior of short-term RIDs did not change for Germany, the Netherlands, and the U.K. when the U.S. is the base country, and for the Netherlands when Germany is the base country.

The results of applying the KPSS test indicate that the null of stationary long-term RIDs could not be rejected for the entire period at the 5 percent significance level or better for all countries when the U.S. is the base country except for France and Germany. The results when Germany is the base country are weaker since the null of stationary long-term RIDs could be rejected at the 5 percent significance level or better for Italy, Japan, and the U.K. The results for the two sub-periods indicate that the behavior of long-term RIDs did not change for all countries before and after 1973 when the U.S. is the base country. When Germany is the base country the results indicate no change in the behavior of the long-term RIDs before and after 1973 for Japan, the Netherlands, and Switzerland.

The results of applying the KPSS test for the entire period on the short-term RIDs indicate that the null of stationarity could not be rejected at the 5 percent significance level or better for Canada, Germany, the Netherlands, Switzerland, and the U.K. when the U.S. is the base country, and for Canada and the Netherlands when Germany is the base country. At the 5 percent significance level or better the results indicate no change in the behavior of the short-term RIDs before and after 1973 for Canada, Germany, and the Netherlands when the U.S. is the base country, and for France, and the Netherlands when Germany is the base country.

Thus, the results of using the standard ADF test with SIC are more supportive than the more powerful ADF-GLS. The next section presents the results of the OLS model with a dummy variable to capture the effect of the transition to the flexible exchange rate system on long-term and short-term RIDs.

### 2.3. The Behavior of RIDs: OLS Estimates

The results of the OLS estimates are reported in tables 7-10 for long-term and short-term RIDs using the U.S. and Germany as base countries.

A finding that $\alpha_0$is statistically significantly different from zero implies significant long-run RIDs pre-1973. For long-term RIDs, the results indicate that $\alpha_0$is statistically significantly different from zero for Canada, France, and Germany when the U.S. is the base country, and for all countries when Germany is the base country except Canada and Italy. For short-term RIDs, $\alpha_0$is statistically significantly different from zero for France and the Netherlands when the U.S. is the base country, and for Japan and the Netherlands when Germany is the base country.

**TABLE 7.**

Behavior of RIDs across fixed and floating exchange rate regimes (U.S. is the base country)

| | Long-term real interest rates | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Country | $\alpha_0$ | $\alpha_1$ | $\rho_0$ | $\rho_1$ | $\frac{\alpha_0}{-\rho_0}$ | $\frac{(\alpha_0+\alpha_1)}{-(\rho_0+\rho_1)}$ | $\rho_0+\rho_1$ | Half-life (in quarters) |
| AU | 0.028 (0.067) | 0.265 (0.515) | −0.419 (−2.298) | −0.329 (−1.665) | 0.067 | 0.392 | −0.748 | *n.a* |
| CA | 0.709 (2.562)** | −0.223 (−0.662) | −0.838 (−5.966)*** | 0.313 (1.954) | 0.846 | 0.926 | −0.525 | 3.72 |
| FR | −0.920 (−2.537)** | 1.109 (2.504)** | −0.643 (−7.766)*** | 0.109 (0.775) | −1.431 | 0.354 | −0.534 | 3.63 |
| GE | 1.350 (3.177)*** | −0.976 (−1.949) | −0.761 (−6.252)*** | 0.283 (1.951) | 1.774 | 0.7842 | −0.478 | 4.26 |
| IT | 0.323 (0.750) | −0.441 (−0.840) | −0.536 (−4.398)*** | −0.003 (−0.017) | 0.603 | −0.219 | −0.539 | 3.58 |
| JA | −0.802 (−1.046) | −0.189 (−0.222) | −1.222 (−5.931)*** | 0.382 (1.698) | −0.656 | −1.180 | −0.840 | 1.51 |
| NE | −0.738 (−1.445) | 1.189 (1.873) | −0.977 (−10.734)*** | 0.351 (2.317)** | −0.755 | 0.720 | −0.626 | 2.82 |
| SW | −0.788 (−1.947) | 0.093 (0.189) | −0.460 (−3.366)** | −0.021 (−0.136) | −1.713 | −1.445 | −0.481 | 4.23 |
| U.K. | 0.560 (1.087) | −0.795 (−1.256) | −1.016 (−6.303)*** | 0.080 (0.441) | 0.551 | −0.251 | −0.936 | 1.01 [2.87][d] |

If the transition to current float caused RIDs to widen as claimed, $\alpha_1$ should be statistically significantly different from zero and imply larger mean differentials post-1973:2. The results indicate that for long-term RIDs$\alpha_1$is statistically significantly different from zero for only France when the U.S. is the base country, and for France, the Netherlands, and Switzerland when Germany is the base country. For short-term RIDs, the results show that $\alpha_1$is statistically significantly different from zero for France,

**TABLE 7**—*Continued*

| | Short-term real interest rates | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Country | $\alpha_0$ | $\alpha_1$ | $\rho_0$ | $\rho_1$ | $\frac{\alpha_0}{-\rho_0}$ | $\frac{(\alpha_0+\alpha_1)}{-(\rho_0+\rho_1)}$ | $\rho_0+\rho_1$ | Half-life (in quarters) |
| AU $^+$ | *n.a.* | *n.a.* | *n.a.* | *n.a.* | *n.a.* | *n.a.* | *n.a.* | *n.a.* |
| CA | 0.129 (0.483) | 0.552 (1.600) | −0.697 (−5.080)$^{***}$ | 0.229 (1.475) | 0.185 | 1.455 | −0.468 | 4.39 |
| FR | −0.961 (−2.427)$^{**}$ | 1.085 (2.185)$^{**}$ | −0.712 (−7.839)$^{***}$ | 0.429 (3.349)$^{***}$ | −1.349 | 0.438 | −0.283 | 8.33 |
| GE | −0.202 (−0.582) | 0.461 (1.074) | −0.765 (−6.173)$^{***}$ | 0.210 (1.414) | −0.264 | 0.467 | −0.555 | 3.42 |
| IT $^+$ | *n.a.* | *n.a.* | *n.a.* | *n.a.* | *n.a.* | *n.a.* | *n.a.* | *n.a.* |
| JA | 0.924 (1.621) | −1.601 (−2.309)$^{**}$ | −0.561 (−5.323)$^{**}$ | −0.192 (−1.353) | 1.647 | −0.899 | −0.753 | 1.98 |
| NE | −1.508 (−2.427)$^{**}$ | 1.699 (2.281)$^{**}$ | −0.922 (−8.596)$^{***}$ | 0.358 (2.315)$^{**}$ | −1.636 | 0.339 | −0.564 | 3.34 |
| SW $^+$ | *n.a.* | *n.a.* | *n.a.* | *n.a.* | *n.a.* | *n.a.* | *n.a.* | *n.a.* |
| UK | −0.026 (−0.047) | 0.442 (0.664) | −0.955 (−5.853)$^{***}$ | 0.149 (0.816) | −0.027 | 0.516 | −0.806 | 1.69 $[3.27]^d$ |

$\Delta r_{ijt} = \alpha_0 + \alpha_1 D + \rho_0 r_{ijt-1} + \rho_1(D)(r_{ijt-1}) + \upsilon_{ijt}$, where $r_{ijt}$ is real interest differential between countries $i$ and $j$ at time $t$. $D$ is a dummy variable that takes the value 1 for observations beginning in 1973:1 and 0 otherwise. $^+$ The regression was not estimated since the sample starts in 1969:3 for Australia, 1971:1 for Italy, and in 1975:4 for Switzerland. **, *** denote significance at the 5 percent and 1 percent significance levels. $^d$ Indicates the average half-life deviations from RIP for $\rho_0 + \rho_1$ (post-Bretton Woods) for all countries excluding Australia since the null of a unit root could not be rejected.

**TABLE 8.**

Behavior of RIDs across fixed and floating exchange rate regimes (Germany is the base country)

| | Long-term real interest rates | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Country | $\alpha_0$ | $\alpha_1$ | $\rho_0$ | $\rho_1$ | $\frac{\alpha_0}{-\rho_0}$ | $\frac{(\alpha_0+\alpha_1)}{-(\rho_0+\rho_1)}$ | $\rho_0+\rho_1$ | Half-life (in quarters) |
| AU | −1.329 (−2.339)** | 1.113 (1.644) | −0.818 (−5.267)*** | 0.243 (1.401) | −1.625 | −0.376 | −0.575 | 3.24 |
| CA | −0.749 (−1.741) | 0.836 (1.598) | −0.801 (−6.359)*** | 0.206 (1.360) | −0.935 | 0.146 | −0.595 | 3.07 |
| FR | −1.886 (−3.541)*** | 1.647 (2.643)*** | −0.593 (−6.452)*** | 0.025 (0.181) | −3.180 | −0.421 | −0.568 | 3.30 |
| GE | *n.a* | *n.a* | *n.a* | *n.a* | *n.a* | *n.a* | *n.a* | *n.a* |
| IT | −0.868 (−1.907) | 0.524 (0.939) | −0.833 (−5.462)*** | 0.578 (2.882)** | −1.042 | −1.349 | −0.255 | 9.42 |
| JA | −3.326 (−3.166)*** | 1.808 (1.586) | −1.282 (−5.836)*** | 0.502 (2.119)** | −0.254 | 1.900 | −0.780 | 1.83 |
| NE | −2.752 (−5.141)*** | 2.701 (4.275)*** | −1.071 (−10.651)*** | 0.114 (0.760) | −2.570 | −0.053 | −0.957 | 0.88 |
| SW | −3.047 (−5.201)*** | 1.378 (2.031)** | −0.901 (−6.788)*** | 0.162 (1.019) | −3.382 | −2.258 | −0.739 | 2.06 |
| U.K. | −1.491 (−2.537)** | 0.659 (0.934) | −1.176 (−6.133)*** | 0.362 (1.744) | −1.268 | −1.022 | −0.814 | 1.65 [2.57]$^d$ |

Japan, and the Netherlands when the U.S. is the base country, and for only Japan when Germany is the base country. The important observation is that for all the cases where $\alpha_1$is statistically significantly different from zero it implies smaller RIDs post-1973 regardless of the base country. Thus, the claim that the current float caused RIDs to widen is not true at least based on the data and the countries used in this study. Goldberg et al. (2003) used quarterly data from 1957:1 to 2000:2 on short-term money market interest rates for Canada, France, Germany, Japan, the United Kingdom, and the United States and reached a similar result.

Coefficients$\rho_0$ and $\rho_1$ are also of interest since they represent speed of convergence to RIP. A finding that $\rho_0 < 0$ is statistically significant would imply that RIDs are mean-reverting. The closer$\rho_0 + \rho_1$to minus one, the faster the speed of convergence, which would imply nearly complete convergence to RIP within the first period. For both long-term and short-term RIDs and regardless of the base country the results indicate that the null hypothesis of a unit root ($H_o : \ \rho_0 = 0$)in equation (11) can be rejected

**TABLE 8**—*Continued*

| | Short-term real interest rates | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Country | $\alpha_0$ | $\alpha_1$ | $\rho_0$ | $\rho_1$ | $\frac{\alpha_0}{-\rho_0}$ | $\frac{(\alpha_0+\alpha_1)}{-(\rho_0+\rho_1)}$ | $\rho_0+\rho_1$ | Half-life (in quarters) |
| AU [+] | *n.a.* | *n.a.* | *n.a.* | *n.a.* | *n.a.* | *n.a.* | *n.a.* | *n.a* |
| CA | *n.a.* | *n.a.* | *n.a.* | *n.a.* | *n.a.* | *n.a.* | *n.a.* | *n.a* |
| FR | −0.777 (−1.682) | 0.813 (1.403) | −0.721 (−7.151)*** | 0.081 (0.540) | −1.078 | 0.056 | −0.640 | 2.71 |
| GE | *n.a.* | *n.a.* | *n.a.* | *n.a.* | *n.a.* | *n.a.* | *n.a.* | *n.a* |
| IT [+] | *n.a.* | *n.a.* | *n.a.* | *n.a.* | *n.a.* | *n.a.* | *n.a.* | *n.a* |
| JA | 1.279 (2.040)** | −2.463 (−3.233)*** | −0.644 (−5.426)*** | −0.230 (−1.532) | 1.986 | −1.354 | −0.874 | 1.34 |
| NE | −1.404 (−2.540)** | 1.300 (1.938) | −1.154 (−9.399)*** | 0.245 (1.498) | −1.217 | −0.114 | −0.909 | 1.16 |
| SW [+] | *n.a.* | *n.a.* | *n.a.* | *n.a.* | *n.a.* | *n.a.* | *n.a.* | *n.a* |
| UK | *n.a.* | *n.a.* | *n.a.* | *n.a.* | *n.a.* | *n.a.* | *n.a.* | *n.a* [1.68][d] |

$\Delta r_{ijt} = \alpha_0 + \alpha_1 D + \rho_0 r_{ijt-1} + \rho_1(D)(r_{ijt-1}) + \upsilon_{ijt}$, where $r_{ijt}$ is real interest differential between countries $i$ and $j$ at time $t$. $D$ is a dummy variable that takes the value 1 for observations beginning in 1973:2 and 0 otherwise. [+] The regression was not estimated since the sample starts in 1969:3 for Australia, 1971:1 for Italy, and in 1975:4 for Switzerland. **, *** denote significance at the 5 percent and 1 percent significance levels. [d] Indicates the average half-life deviations from RIP for $\rho_0+\rho_1$ (post-Bretton Woods) for all countries.

at the five percent significance level or better for all countries except Australia's long-term RIDs when the U.S. is the base country. The estimated averages of coefficients of adjustment for all countries are 0.38 and 0.43 when the U.S. is the base country, and 0.34 and 0.19 when Germany is the base country for long-term and short-term RIDs respectively, which implies half-lives of deviations from RIP of 2.87 and 3.27 quarters for long-term and short-term RIDs when the U.S. is the base country, and 2.57 and 1.68 quarters for long-term and short-term RIDs when the Germany is the base country.

Since the claim that the transition to the current float has caused RIDs to widen has not been supported based on the previous results and the dummy variable for most of the cases was not significant, an OLS model with no dummy variables:$\Delta r_{ijt} = \alpha_0 + \rho_0 r_{ijt-1} + v_{ijt}$is also estimated. The results in tables 9 and 10 indicate that the null of a unit root can be rejected at the five percent significance level or better for all countries' long-term and short-term RIDs and regardless of the base country. The estimated averages of coefficients of adjustment for all countries are 0.32 and 0.45 when the U.S. is the base country, and 0.30 and 0.28 when Germany is the base country for long-term and short-term RIDs respectively, which implies half-lives of deviations from RIP of 2.46 and 3.43 quarters for long-term and short-term RIDs when the U.S. is the base country, and 2.30 and 2.20 quarters for long-term and short-term RIDs when the Germany is the base country.

The results indicate the magnitudes of the speed of convergence to RIP with a dummy variable that takes a value of one in 1973 to capture the effect of the transition to the current float on RIDs are not significantly different from the results obtained from the OLS model without the dummy variable. The only exception is for Germany's short-term RIDs (1.68 quarters for with the dummy variable and 2.20 quarters without the dummy variable), the results for Germany should be interpreted carefully due to missing data for most countries pre-1973. This supports the neutrality proposition, which states that the behavior of real variables is not affected by the nominal exchange rate system in place (Lothian and McCarthy, 2002).

## 3. SUMMARY AND CONCLUSIONS

This paper tests the validity of the RIP theory for a group of industrialized countries using quarterly data from 1957:1 to 2003:1 on long-term and short-term interest rates. As a measure of international financial markets

**TABLE 9.**

dynamics of RIDs (U.S. is the base country) ++

| | Long-term real interest rates | | | |
|---|---|---|---|---|
| Country | $\alpha$ | $\rho$ | $\frac{\alpha}{\rho}$ | Half-life (in quarters) |
| AU | 0.215<br>(0.880) | −0.699<br>(−9.867)*** | 0.308 | 2.31 |
| CA | 0.532<br>(3.371)*** | −0.597<br>(−8.782)*** | 0.891 | 3.05 |
| FR | −0.149<br>(−0.723) | −0.562<br>(−8.607)*** | −0.265 | 3.36 |
| GE | 0.606<br>(2.703)*** | −0.548<br>(−8.303)*** | 1.106 | 3.49 |
| IT | 0.033<br>(0.137) | −0.529<br>(−8.230)*** | 0.062 | 3.68 |
| JA | −0.994<br>(−3.007)*** | −0.899<br>(−10.779)*** | −1.106 | 1.21 |
| NE | 0.173<br>(0.571) | −0.826<br>(−11.285)*** | 0.209 | 1.58 |
| SW | −0.731<br>(−3.218)*** | −0.477<br>(−7.521)*** | 1.532 | 4.28 |
| U.K. | 0.023<br>(0.077) | −0.944<br>(−12.733)*** | 0.024 | 0.96<br>[2.46][d] |

integration, RIP states that real interest rates should be equalized across national boundaries, in which case the ability of monetary authorities to influence real rates of interest and other variables that depend upon them will be severely limited to the extent that the monetary authority can influence the world real rate of interest.

The parity has received a great deal of attention over the past two decades following two important events: the collapse of the Bretton Woods system in 1973 and the increase in the degree of international financial integration due to the removal or substantial reduction of many capital controls in the 1970s and 1980s. Whereas the increase in the degree of international financial integration should equalize real interest rates across countries, this equalization may not be obtained under systems of flexible exchange rates due to high exchange rates volatility and foreign exchange risk premium. The results of the previous empirical studies are mixed; with different studies using different tests and different data sets reaching different results. Different reasons have been put forward to explain the weak evidence in favor of RIP given the increase in the degree of international financial inte-

**TABLE 9**—*Continued*

| | Short-term real interest rates | | | |
|---|---|---|---|---|
| Country | $\alpha$ | $\rho$ | $\frac{\alpha}{\rho}$ | Half-life (in quarters) |
| AU + | −0.005<br>(−0.014) | −0.537<br>(−6.952)*** | −0.009 | 3.6 |
| CA | 0.492<br>(2.888)*** | −0.491<br>(−7.676)*** | 1.002 | 4.10 |
| FR | −0.109<br>(−0.450) | −0.468<br>(−7.234)*** | −0.233 | 4.39 |
| GE | 0.123<br>(0.601) | −0.613<br>(−8.947)*** | 0.201 | 2.92 |
| IT + | 0.211<br>(0.716) | −0.394<br>(−5.561)*** | 0.536 | 5.53 |
| JA | 0.004<br>(0.013) | −0.610<br>(−8.958)*** | 0.007 | 2.94 |
| NE | −0.247<br>(−0.701) | −0.720<br>(−9.269)*** | −0.343 | 2.18 |
| SW + | −0.655<br>(−2.022)** | −0.322<br>(−4.518)*** | −2.034 | 7.13 |
| UK | 0.273<br>(0.866) | −0.833<br>(−11.347)*** | 0.328 | 1.55<br>[3.43][d] |

$\Delta r_{ijt} = \alpha_0 + \rho_0 r_{ijt-1} + \upsilon_{ijt}$ where $r_{ijt}$ is real interest differential between countries $i$ and $j$ at time $t$. + The sample starts in 1969:3 for Australia, 1971:1 for Italy, and in 1975:4 for Switzerland. ++ No time dummies are included. **, *** denote significance at the 5 percent and 1 percent significance levels. [d] Indicates the average half-life deviations from RIP for all countries.

gration: 1- the lack of power in the standard unit root tests, 2- short spans of data, 3- the base country, and 4- the high exchange rate volatility during the current float.

The results in this paper indicate that using the more powerful ADF-GLS test does not seem to provide stronger support for RIP; the standard ADF test shows more support in favor of RIP for the entire period and for the two sub-periods. The evidence is also weak when the KPSS test is used relative to the standard ADF test. The evidence of in favor of RIP is weaker for two sub-periods than for the entire period. This indicates that unit root tests in general have low power in short time spans, which means that the probability of rejecting a false null hypothesis will be low, thus committing type II error. As for the issue of the base country and based on the standard ADF test –since it shows more evidence in favor RIP, the results for the entire period show that the outcomes for long-term RIDs are not sensitive to the choice of the base country since the null hypothesis

**TABLE 10.**

Dynamics of RIDs (Germany is the base country) ++

| | Long-term real interest rates | | | |
|---|---|---|---|---|
| Country | $\alpha$ | $\rho$ | $\frac{\alpha}{\rho}$ | Half-life (in quarters) |
| AU | −0.491<br>(−1.615) | −0.612<br>(−8.940)*** | −0.802 | 2.93 |
| CA | −0.141<br>(−0.582) | −0.642<br>(−9.272)*** | −0.220 | 2.70 |
| FR | −0.713<br>(−2.565)** | −0.519<br>(−7.998)*** | −1.374 | 3.79 |
| GE | *n.a* | *n.a.* | *n.a* | *n.a* |
| IT | −0.450<br>(−1.690) | −0.429<br>(−7.066)*** | −1.049 | 4.95 |
| JA | −1.752<br>(−4.258)*** | −0.848<br>(−10.229)*** | −2.066 | 1.47 |
| NE | −0.839<br>(−2.866)*** | −0.918<br>(−12.425)*** | −0.914 | 1.11 |
| SW | −2.029<br>(−6.831)*** | −0.765<br>(−10.532)*** | −2.652 | 1.91 |
| U.K. | −0.951<br>(−2.952)*** | −0.867<br>(−11.747)*** | −1.097 | 1.37<br>[2.30][d] |

of a unit root is rejected for all countries at the five percent significance level or better. The results for short-term RIDs are slightly different since they indicate that the null of a unit root cannot be rejected for Italy and Switzerland when the U.S. is the base country. The results for the two sub-periods are generally similar; thus, indicating that overall the results of the unit root tests are not sensitive to the choice of the base country.

Regarding the high volatility of exchange rates under the current float and it is impact on RIDs, the results of the OLS models with a dummy variable to capture the effect of the transition to the current float on RIDs indicate that the dummy variable is not significant for most of the countries and even for the countries where it is found to be statistically significantly different from zero it indicates a smaller RIDs post-1973, which means that the current float did not cause RIDs to widen as claimed. This result is consistent with the neutrality proposition, which states that the behavior of real variables is not affected by the nominal exchange rate system in place. The other important observation is the speed of convergence to RIP, that is, the time it takes for the half-life devotions from RIP to decay by 50 percent. On average, for both long-term and short-term RIDs and

**TABLE 10**—*Continued*

| | Short-term real interest rates | | | |
|---|---|---|---|---|
| Country | $\alpha$ | $\rho$ | $\frac{\alpha}{\rho}$ | Half-life (in quarters) |
| AU $^{+}$ | −0.208<br>(−0537) | −0.560<br>(−7.131)$^{***}$ | −0.371 | 3.38 |
| CA | 0.808<br>(2.740)$^{***}$ | −0.770<br>(−8.545)$^{***}$ | 1.049 | 1.89 |
| FR | −0.247<br>(−0.891) | −0.668<br>(−9.175)$^{***}$ | −0.370 | 2.51 |
| GE | *n.a* | *n.a* | *n.a* | *n.a* |
| IT $^{+}$ | 0.074<br>(0.244) | −0.408<br>(−5.734)$^{***}$ | 0.181 | 5.29 |
| JA | −0.133<br>(−0.384) | −0.698<br>(−9.873)$^{***}$ | −0.191 | 2.32 |
| NE | −0.485<br>(−1.541) | −0.997<br>(−12.296)$^{***}$ | −0.486 | 0.48 |
| SW $^{+}$ | −1.428<br>(−4.030)$^{***}$ | −0.632<br>(−7.032)$^{***}$ | −2.259 | 2.77 |
| UK | 0.374<br>(0.949) | −0.999<br>(−10.612)$^{***}$ | 0.374 | 0.40<br>[2.20]$^{d}$ |

$\Delta r_{ijt} = \alpha_0 + \rho_0 r_{ijt-1} + \upsilon_{ijt}$, where $r_{ijt}$ is real interest differential between countries $i$ and $j$ at time $t$. $^{+}$ The sample starts in 1969:3 for Australia, 1971:1 for Italy, and in 1975:4 for Switzerland. $^{++}$ No time dummies are included. **, *** denote significance at the 5 percent and 1 percent significance levels. $^{d}$ Indicates the average half-life deviations from RIP for all countries.

regardless of the base country, it takes between two to three quarters for half-life devotions from RIP to decay by 50 percent.

## APPENDIX: DATA DESCRIPTION

Quarterly data from 1957:1 to 2003:1 on the nominal interest rates and the consumer price index (CPI) are obtained from the International Monetary Fund's (IMF) International Financial Statistics (IFS) (CD-ROM, June 2003). Three nominal interest rates are used: the short-term interest rate (line 60C, or 60B), and the long-term interest rate (line 61). The sample period for the CPI (line 64) for all countries is 1957:1 — 2003:1. The following table summarizes the sample period and the number of observations for each country, where the numbers in parentheses represent the number of observations.

The following table provides definition of the data as obtained from the IMF's International Financial Statistics.

**TABLE 1.**

Data and sample period

| | Sample period | |
|---|---|---|
| Country | Short-term interest rate | Long-term interest rate |
| AU | 1969:3 – 2003:1 (135) | 1957:1 – 2003:1 (185) |
| CA | 1957:1 – 2003:1 (185) | 1957:1 – 2003:1 (185) |
| FR | 1957:1 – 1999:1 (169) | 1957:1 – 2003:1 (185) |
| GE | 1957:1 – 2003:1 (185 for 60B and 111 for TB rate) | 1957:1 – 2003:1 (185) |
| IT | 1971:1 – 2003:1 (129) | 1957:1 – 2003:1 (185) |
| JA | 1957:1 – 2003:1 (185) | 1966:4 – 2003:1 (146) |
| NE | 1960:1 – 1998:4 (156) | 1957:1 – 2003:1 (185) |
| SW | 1975:4 – 2003:1 (110) | 1957:1 – 2003:1 (185) |
| U.K. | 1957:1 – 2003:1 (185) | 1957:1 – 2003:1 (185) |
| U.S. | 1957:1 – 2003:1 (185) | 1957:1 – 2003:1 (185) |

**TABLE 2.**

Definition of data

| Country | Short-term interest rate | | Long-term interest rate | |
|---|---|---|---|---|
| | IMF's line | Notes | IMF's line | Notes |
| AU | 60B...ZF | Average rate on money market | 61...ZF | Treasury bond: 15 years |
| CA | 60C...ZF | TB rate | 61...ZF | GB yield > 10 years |
| FR | 60B...ZF | Call money rate | 61...ZF | GB yield |
| GE | 60C...ZF<br>60B...ZF | TB rate<br>Call money rate | 61...ZF | GB yield |
| IT | 60B...ZF | Money market rate | 61...ZF | GB yield |
| JA | 60B...ZF | Call money rate | 61...ZF | GB yield |
| NE | 60B...ZF | Call money rate | 61...ZF | GB yield |
| SW | 60B...ZF | Money market rate | 61...ZF | GB yield |
| U.K. | 60C...ZF | TB rate | 61...ZF | GB yield |
| U.S. | 60C...ZF<br>60B...ZF | TB rate<br>Federal funds rate | 61...ZF | GB yield: 10 years |

TB stands for Treasury bill, and GB stands for government bond

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