Interest Rate Linkages and Capital Market Integration: Evidence from the Americas

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Abstract

In this paper, we study the long-run co-movement among the real interest rates of the U.S., Canada, and a select group of Latin American countries to assess the extent of financial market integration between these countries during a period of high capital mobility. The findings of the study support a long-run relationship between the short-term U.S. real interest rate and those of the Latin American countries, while it fails to support such a relationship between the U.S. and Canadian real interest rates.

1. Introduction

During the last thirty years, many developments contributed to the process of international financial market integration. Removal of capital controls in the 1970s by the major developed countries provided the initial impetus for financial market integration by facilitating cross-border capital movement. Economic liberalization and financial deregulations of the 1980s opened up national markets making way for greater financial integration. As globalization and integration of international goods markets advance with lessening of tariffs and other constraints, there will be further impetus to the changes in the financial markets.

While the financial integration is generally thought to be advancing well among developed countries, evidences have emerged to suggest that markets of many developing countries in the Far East and Latin America are not lagging behind in getting themselves integrated with global financial markets. Massive inflows of capital into these countries following their economic liberalization and financial deregulation in the early 1990s played a key role in this respect and these inflows are not likely to diminish as these countries continue to deregulate and liberalize their financial markets.

When financial markets are integrated, events in one country will have its impact felt in the financial markets of other countries. How quickly and to what extent these impacts will be felt depends on the degree of integration existing at the time. Characteristics of fully integrated financial markets would include equalization of prices of similar financial assets across markets. Market integration has far reaching implications for cross-border capital flows, arbitrage trading, financial management, and monetary policy autonomy. Many studies in the past have investigated the integration issue. Some date back to the 1970s. This issue received added attention among researchers when the eighties rolled in with increased interest in liberalization and deregulation around the world.

Financial market integration studies usually focus on the differentials in the asset prices or sensitivity of international capital flows to asset price differentials. Studies that have used the asset price differential approach have either focused on nominal interest rate or real interest rate differentials.[1] Their examination of the relationships between interest rates was typically carried out from the perspective of parity, covariability and/or convergence to assess the extent of integration.

Almost all past financial market integration studies have focused on developed countries, either because they were the obvious case for the study due to strong economic and financial linkage that exist among them or because of the availability of market data. Only recently, some interest has been shown for the study of the integration issue from the perspective of developing countries.[2] The main purpose of this paper is to examine the issue of financial integration from the perspective of a select group of Latin American countries whose participation in global capital markets since the late eighties is rather well known.

2. Theory and Methodology

In a world of fixed exchange rate and perfect capital mobility, nominal interest rates will be equal across markets. If the exchange rates are flexible and the capital market is imperfect, interest rate difference will persist. Two versions of interest rate parity - covered interest parity (CIP) and uncovered interest parity (UIP) - are usually used to explain the difference between interest rates.

$$i_{t+n} - i^*_{t+n} = (F_{t+n} - S_t)/S_t \qquad \text{CIP} \qquad (1)$$

$$i_{t+n} - i^*_{t+n} = [E(S_{t+n}) - S_t]/S_t \qquad \text{UIP} \qquad (2)$$

where i_{t+n}, i^*_{t+n} are the nominal interest of domestic and foreign countries; F_{t+n} and S_t are the n-month forward and the spot rate. The exchange rate is defined as domestic currency value of the foreign currency.

Neither CIP nor UIP can explain the persistence of interest rate difference in all circumstances. The usual explanation for the presence of interest rate difference among countries, which have well developed financial markets and have no barriers to capital flow, is the influence of exchange rate expectation, exchange rate risk and default risk.[3] In the case of other countries characterized by barriers to capital flow, transaction cost

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[1] See Bhoocha-oom, et. al., 1990; Cumby and Mishkin, 1986; Faruque, 1992; Goodwin and Grunnes, 1994; Mark, 1985; and Phylaktis, 1999..

[2] Edwards (1998) makes some reference to capital market integration in the Latin American countries.

[3] Favero et al. (1996) have found that expectations about exchange depreciation and about default risk have been important factors in explaining the spread of interest rates between Germany and the “high-yielders” of Italy, Spain, and Sweden.

and other differences in the instruments except the maturity, political risk, the interest rate difference is further explained by these factors.[4]

Following the approach used by Throop (1994), we incorporate the above factors in (1) and (2) as follows,

$$i_{t+n} - i^{*}_{t+n} = (F_{t+n} - S_t)/S_t + DMD + BAR \quad (3)$$

$$i_{t+n} - i^{*}_{t+n} = [E(S_{t+n}) - S_t]/S_t + DMD + BAR + CRISK \quad (4)$$

where DMD = differences in the securities other than maturity, BAR = barriers to capital flows, and CRISK = currency risk premium.

Appealing to the Purchasing Power Parity and uncovered interest rate parity conditions, (which establish the equality between the expected change in the exchange rate and the inflation rate differential and expected exchange rate change and the interest rate differential respectively, we can rewrite (4) to obtain a general function to explain the long-run relationship between real interest rates.[5]

$$i_{t+n} - i^{*}_{t+n} = \pi_{t+n} - \pi^{*}_{t+n} + DMD + BAR + CRISK$$

$$(i_{t+n} - \pi_{t+n}) - (i^{*}_{t+n} - \pi^{*}_{t+n}) = DMD + BAR + CRISK$$

$$r_{t+n} - r^{*}_{t+n} = DMD + BAR + CRISK \quad (5)$$

where π and π^* are expected inflation rates

The equation (5) specifies that any persistence of real interest rate differential must be the result of factors represented by DMD, BAR and CRISK. As long as any one of these factors is present, real interest rates will not converge to equality. Pigott (1993) observes that no systematic tendency for cross-country disparity among either the nominal or the real rates to decline appears to exist despite the increasing reduction in barriers to capital flow during the 70s and 80s. Throop (1994) rejects the hypothesis of real rate convergence to equality among major developed countries and concludes that only a weak form for convergence may exist. Even in the absence of capital controls and other structural imperfections as would be expected in major developed countries, exchange rate expectation and exchange rate risk will prevent the convergence real interest rates to equality. This means that real interest rate difference will persist even in the face of substantial financial market integration and market efficiency due to currency risk premium and expectations errors.

A weak form of convergence means that the real interests will differ by an amount determined by the factors represented by DMD, BAR, and CRISK factors. Any deviation

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[4] See Devine(1997), Throop(1994), and Favero et al. (1996) for discussion of these factors.

[5] The Purchasing Power Parity condition holds in the long run according many empirical studies.

from the band defined by these factors will be eventually eliminated in efficient and integrated markets. That is, they will not drift apart through time. It means that the real interest rates which are non-stationary may have an equilibrium relationship in the long run, that is, they may be cointegrated. This will also imply that real rate differential will be stationary. Therefore, confirmation of the stationarity property of real rate differential will lend support to the existence of cointegrating relationship between the real rates.

3. Past Evidence

Past studies on the relationship between real interest rates have produced mixed results. Testing for equalization of real interest rates across countries with data for 1973 to 1984 period, Mark (1985) rejects the null hypothesis of equality. Cumby and Mishkin (1986) find strong positive association between the U.S. and the foreign short-term real interest rates, but concludes the linkage is not complete. Karifakis and Moschos (1990) find no cointegrating relationship between German short-term nominal interest rate and those of other EMS countries during the period from 1979 to 1988. Findings of Kirchgassner and Wolters (1995), on the other hand, provide strong evidence for the existence of long-run relations between the short-term German (nominal) interest rate and other EMS rates using data for the period from 1974 to 1994. Throop (1994) finds no evidence of any significant long-run relationship between the short-term and the long-term US interest rates and those of the major industrialized countries during the 1980s, a period of high capital mobility. The only exception in his finding is the relation between the US short-term real rate and the trade-weighted foreign short-term real rate. Goodwin & Grennes (1994), however, finds support for long-run stable relationship between short-term real rates of the US and those of most European countries and Japan. Phylaktis (1999) examines the extent of capital market integration in a group of Pacific Basin countries for the sample period of 1973 to 1993 using three-month ex-post real rates and reports a close linkage between the markets of these countries and the world financial markets.

4. The Model

In this paper, we focus on the behavior of the real interest rates of a select group of countries from Latin America, Canada and of the US to examine financial market integration. One hypothesis commonly tested in the past is that in fully integrated markets real interest rates are equal, i.e., real interest parity must hold exactly. The traditional test of real interest parity and financial market integration involves the estimation of a regression equation of the following type:

$$r_t^{\,i} = \alpha_0 + \alpha_1 r_t^{\,j} + \varepsilon_t \qquad (6)$$

where $r_t^{\,i}$ and $r_t^{\,j}$ are the real interest rates in country i and j. If the joint hypothesis of $\alpha_0=0$ and $\alpha_1=1$ is not rejected, results support the real interest parity.[6] Though, in theory, real interest parity is a good indication of financial market integration, this approach suffers from two major weaknesses. First, in the presence of market imperfections and barriers to capital flows, discussed in the previous section, the test will invariably result

[6] See Cumby and Miskin 1986.

in the rejection of real interest parity in the strict sense. Second, the regression results for the traditional model are based on the assumption that the real rate series are stationary, which may not be always true.[7]

These problems can be overcome by examining the long-run relationship between real interest rates using cointegration approach. In a cointegration testing procedure, one appeal to the fact that two or more variables, which are non-stationary taken individually, may be cointegrated resulting in any deviation from their equilibrium position being stationary.

Our examination of the real interest rate behavior essentially involves the relationship outlined in Equation 5.

$$r_{t+n} - r^*_{t+n} = DMD + BAR + CRISK$$

Empirically, it amounts to testing the weak-form convergence of real interest rates. (The strong-form convergence would, however, imply a tendency toward equality.) Our empirical work involves the following. First, we test for unit roots in the real rate series and report the results. Second, we examine the bivariate cointegration relationship between the US real interest rate and the real interest rates of Canada and the four Latin American countries and multivatiate cointegration among all countries using a procedure developed by Johansen(1988) and Juselius(1990). Under Johansen's approach, we estimate the following vector autoregressive models:

$$\Delta x_t = A_o + \pi x_{t-1} + \sum_{i=1}^{P-1} \pi_i \Delta x_{t-i} + \varepsilon_t$$

where x is a vector of real interest rates. The Johansen trace test allows us to determine the number of cointegrating vectors in the system.

5. Empirical Results

The study uses the end-of-the month data on three-month Treasury Bill rates for the U.S., Canada, Mexico, Brazil, and 3-month time deposit rates for Chile and Argentina, and monthly inflation rates for all countries. Three-month inflation rate is measured from the consumer price indices. The data covers a period from January 1986 to December 2003. Nominal Interest rate and CPI data for the study is obtained from International Monetary Fund and Global Fin Data.

There are two approaches for calculating the real interest rate: ex-ante and ex-post. The ex-post real interest rate is defined as

$$r_{t,n} = i_{t,n} - \pi_{t,n}$$

[7] See Phylaktis 1999, Mishkin, 1995, and Goodwin and Grennes (1994).

where $r_{t,n}$ is the real rate at time t for period n; $i_{t,n}$ is the nominal n period rate; and $\pi_{t,n}$ is the n period inflation rate.

The ex-ante real interest rate is defined as

$$r_{t,n} = i_{t,n} - E(\pi_{t,n})$$

where $E(\pi_{t,n})$ is the n period expected inflation rate.

We use the ex-ante measure of real interest rate in this study. For calculating the ex-ante real rate, the expected inflation rate for the three-month period is measured by the annualized percentage change in the CPI index during preceding 3-month period. As pointed by Mishkin (1981 and 1988), expected inflation rate can be substituted by the actual inflation rate under the assumption of rational expectation.

5.1 Unit root tests

Before testing for a long-term relationship between the real rates, we tested for unit roots in each of the series using Augmented Dickey Fuller test. The test uses the following regression:

$$\Delta r_t = \alpha + \gamma r_{t-1} + \sum_{i=1}^{P-1} \theta_i \Delta r_{t-i} + \varepsilon_t$$

The null hypothesis of unit root is rejected if the estimated value of γ is negative and significantly different from zero. We find that the null hypothesis of unit root can be rejected for the four Latin American countries at 1% significance level and it is not rejected for the U.S. and Canada at 10% significance level. This finding runs counter to the findings of some recent studies.[8] The results of unit-root test are reported in Table 1.

Table 1: Augmented Dickey-Fuller (URADF) unit root test for real interest rates. [a]

Country	Lag Order (p)[b]	t statistic	Φ1 statistic[c]
Argentina	2	-7.07	25.03
Brazil	0	-9.55	45.64
Canada	0	-1.32	1.02
Chile	2	-7.17	25.82
Mexico	1	-6.24	19.50
United States	3	-1.23	0.96

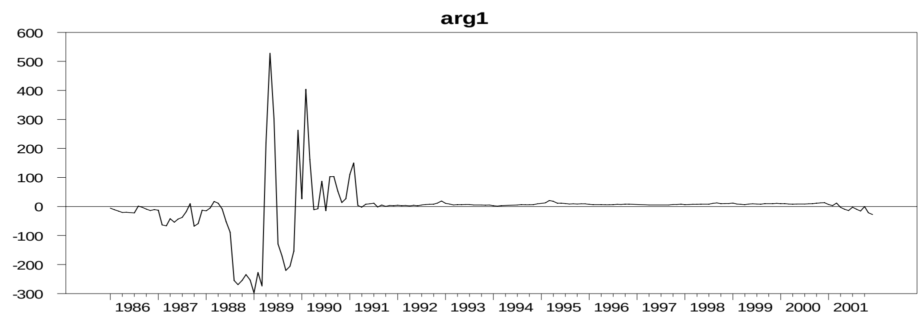
[a] Critical values at 1%, 5%, and 10% are –3.46, -2.88 and –2.57.
[b] Lag order is chosen using Schwarz's (1978) Bayesian Information Criterion.
[c] Joint test of a unit root and no constant. Critical values at 1%, 5%, and 10% are 6.52, 4.63, and 3.81

[8] Plylaktis (1999) finds all real rate series in her study to be non-stationary in levels. Throop (1994) also find the same for both short-term and long-term real rates. Goodwin & Grennes (1994) find 15 out 20 real rate series to be non-stationary.

The table also includes results of a joint test of a unit root and no constant. For all Latin American countries in the sample, the null of a unit root and no constant and for the US and Canada it is accepted at 1% significance level.

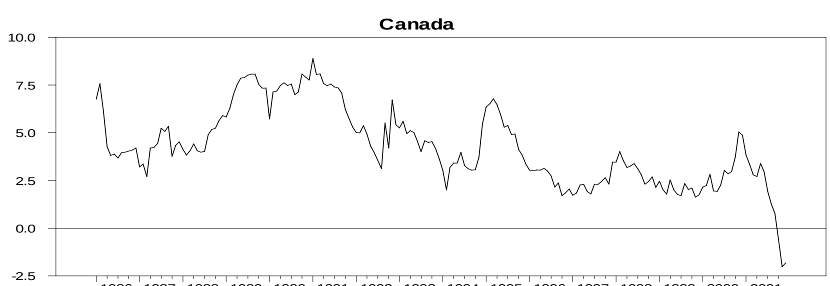
Figure 1(a) to 1(f) below presents the graphs of the real rates in level.

Figure 1 (a)

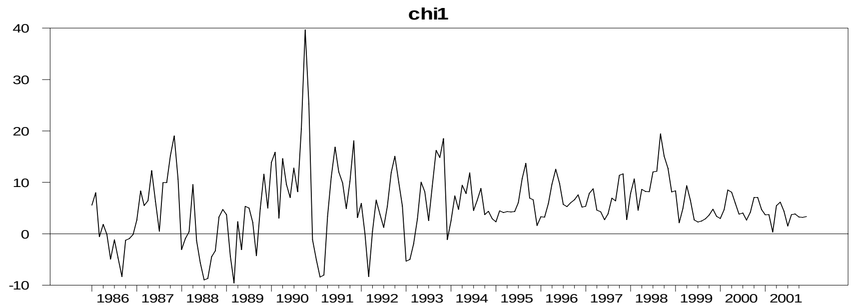


(b)

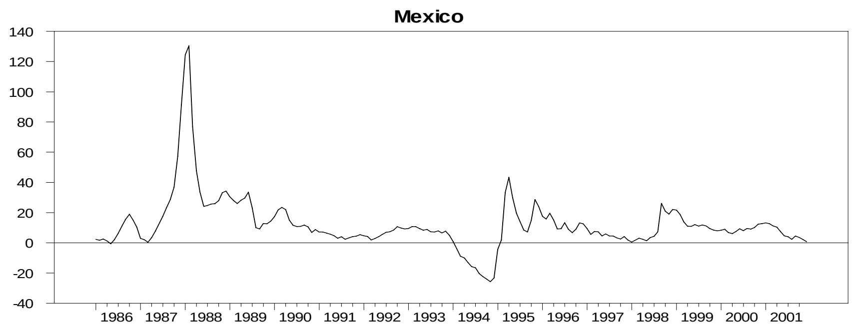
(c)



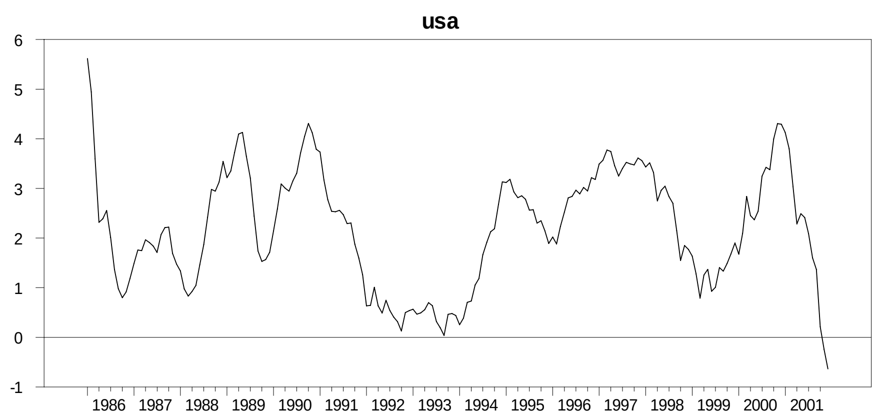
(d)



(e)



(f)



5.2 Cointegration tests

The results of bivariate cointegration tests using Johanson's procedure is reported in Table 2. These results support cointegrating relationship between the real interest rates of the U.S. and the four Latin American countries, but fail to support it for the U.S. and the Canadian real interest rates.

Table 2: Bivariate Cointegration Test[a]

Country pair	Johansen's λ_{trace} statistics [a]	
	H_0: $r = 0$	H_0: $r \leq 1$
US-Argentina	45.13	3.34
US-Brazil	72.54	3.34
US-Canada	8.88	3.26
US-Chile	58.07	3.36
US-Mexico	45.93	3.44

[a] Critical values at 5% for $r = 0$ is 20.16 and for $r \leq 1$ is 9.14. Test uses 2 lags.

Next, we examine whether there exist cointegrating relationships among real interests of the US and Canada and each of the Latin American country. Consider the following three-variable relationship:

$$r_{it} = \beta_0 + \beta_1 r_1 + \beta_2 r_2 + e_t$$

where r_{it} , r_1, and r_2 represent real interest rates in a Latin American country, USA and Canada respectively.

The results of these tests are presented in table 3.

Table 3: Multivariate Cointegration Test[a]

Country	Johansen's λ_{trace} statistics [a]		
	H_0: $r = 0$	H_0: $r \leq 1$	H_0: $r \leq 2$
Argentina	52.98	8.36	2.03
Brazil	86.32	8.73	2.09
Chile	65.14	8.35	2.04
Mexico	50.35	8.53	1.97

[a] Critical values at 5% for $r = 0$ is 24.21, for $r \leq 1$ is 12.28 and for $r \leq 2$ is 4.04. Test uses two lags.

For all the four countries listed in the first column, null of no cointegration is rejected and the null of one cointegrating relationship is accepted at 5% level of significance. Since no cointegrating relationship exists between the US and Canadian real interest rates, the interpretation of the above findings is that the real interest rate of each of Latin American countries considered here follows a time path determined by events in the US and Canada.

The next test explores the cointegrating relationship among all the countries considered in the study. The results are presented in table 4.

Table 4: Multivariate Cointegration Test (all countries)

H_0:	Johansen's λ_{trace} statistics	
	λ_{trace}	Critical value at 5%
$r = 0$	266.87	103.68
$r \leq 1$	175.76	76.81
$r \leq 2$	93.17	53.94
$r \leq 3$	47.08	35.07
$r \leq 4$	9.91	20.16
$r \leq 5$	2.83	9.14

As the trace test indicates, we can accept the null of four cointegrating relationships in the system.

5.2 An Altenative Approach

An alternative approach to testing financial market integration which allows for non-synchronous variation in real rates within a band defined by transaction cost and other fixed difference as explained by Equation 5 is also considered below.[9] In this framework, national real interest rates are allowed to differ by a stationary factor. It has the advantages in that none of the rates need be treated as exogenous and the rates can be used regardless of their non-stationarity status. Statistically, the approach involves testing for stationary properties of the differentials. The results of the Augmented Dickey-Fuller test are reported in Table 5. The unit root tests support the stationarity of real rate differentials in every case except US-Canada.

Table 5. Unit root test for real interest rate differentials between the US, Canada and the four Latin American countries. [a]

Countries	Augmented Dickey-Fuller Test		
	Lag order(p)[b]	t statistic	Φ1 statistic[c]
Argentina	2	-7.08	25.09
Brazil	0	-9.55	45.64
Canada	2	-2.25	2.54
Chili	0	-7.63	29.11
Mexico	1	-6.36	20.28

[a] Critical values at 1%, 5%, and 10% are –3.46, -2.88 and –2.57.
[b] Lag order is chosen using Schwarz's (1978) Bayesian Information Criterion.
[c]Joint test of a unit root and no constant. Critical values at 1%, 5%, and 10% are 6.52, 4.63, and 3.81

[9] See Goodwin(1994)

The table also includes results of a joint test of a unit root and no constant. For all Latin American countries in the sample, the null of a unit root and no constant is rejected and for the US and Canada it is accepted at 1% significance level. The results of the alternative test confirm the earlier findings.

Conclusion

In this study, we examined the relationship between the short-term real rates in the U.S., Canada, and four Latin American countries for evidence of financial market integration. Using stationarity and cointegration tests on real interest rates and on the real rate differentials, we find support for capital market integration of the weak form between the U.S. and the four Latin American countries, but not between the U.S. and Canadian markets. The failure of the data to support financial market integration between the U.S. and Canada, while supporting it for the four Latin American countries is somewhat surprising. Throop (1994) had also found no evidence of cointegrating relationship between the U.S. and Canada. The second surprising element in the result is the stationarity properties of the real interest rates. Rejection of null hypothesis of unit root for the real rates of Latin American countries goes against the conventional belief that all financial variables are generally non-stationary.

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