THE DETERMINATION OF THE COSTA RICA COLON/USD EXCHANGE RATE

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ABSTRACT

The purpose of this paper is to compare four major exchange rate models for the Costa Rica Colon. We examine exchange rate data for the Costa Rica/U.S. dollar relationship from 1981-2007 and find that monetary models have a higher explanatory ability whereas the Mundell-Fleming model performs better in forecasting exchange rates than other models. The coefficient of the interest rate differential in the uncovered interest parity model has a wrong sign.

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INTRODUCTION

After many years of adopting the crawling peg exchange rate regime, the Costa Rican authorities have moved to a crawling band system and modified monetary policy and other procedures to foster exchange rate flexibility. The expected inflation rate has been used to determine the change in crawl of the exchange rate. A narrowed spread for foreign exchange transactions with the central bank has been opened to promote interbank market development. The central bank has established an electronic mechanism to handle transactions in foreign exchange market. New rules have been issued to raise the limit on changes in foreign exchange positions. The overnight rate has replaced the 30-day deposit rate to become the policy rate.

The Costa Rica Colon/USD exchange rate has depreciated in the long run from 8.57 in 1980 to 308.19 in 2000 and 517.9 in 2006. One possible cause for a weaker Costa Rica Colon (CRC) may be due to declining interest rates in order to stimulate consumption and investment spending. For example, the deposit rate in Costa Rica reached a high of 27.32% in 1991 and then declined to 13.38% in 2000 and 9.77% in 2006. The uncovered interest parity model suggests that a declining domestic interest rate relative to the world interest rate would cause the Colon to depreciate, holding other factors constant. Other possible reasons for a weaker Costa Rica Colon are a relatively high inflation rate, more money supply, and high output growth. During 2000-2006, the inflation rate, M2 money, and real GDP increased at an annual rate of 14.89%, 38.03%, and 5.31%, respectively.

This paper attempts to examine the behavior of the CRC/USD exchange rate and has several focuses. First, four different models are considered. They include the purchasing power parity model (Taylor and Taylor, 2004; Taylor 2006; Breitung and Candelon, 2005; Yotopoulos and Sawada, 2006; Alba and Papell, 2007), the uncovered interest parity model (Dekle, Hsiao, and Wang, 2002; Chinn and Meredith, 2004), the monetary models (Meese and Rogoff, 1983; Chinn, 1999, 2000; Cheung, Chinn, and Pascual, 2005), and the Mundell-Fleming model (Romer, 2001; Hsing, 2005, 2007). Second, in the monetary models, four different versions proposed by Dornbusch (1976), Frenkel (1976), Bilson (1978), and Frankel (1979) are compared. Third, in the Mundell-Fleming model, comparative-static analysis is applied to determine the impact of a change in an exogenous variable on the equilibrium exchange rate. Fourth, the Newey-West (1987) method is applied in order to address the issue of both autocorrelation and heteroskedasticity when their forms are unknown.

The remainder of the paper is organized as follows. In the following section we discuss the literature related to exchange rates. This section is followed by a discussion of the models that are tested in the paper. Two sections follow that discuss the data used for the empirical tests along with the results of the empirical tests. The paper closes with some concluding comments.

LITERATURE REVIEW

This section reviews several recent articles of exchange rate determination and related subjects. Jalbert, Stewart and Jalbert (2006) examine the efficiency and rate spread of the Costa Rica certificate of deposit (CD) market. Contrary to conventional wisdom, U.S. banks are found to pay higher rates than Costa Rican banks on dollar denominated CDs. Empirical tests reveal uncovered interest rate arbitrage opportunities. Breitung and Candelon (2005) show that before 1997, PPP holds for Asian countries but not for Latin American countries and that long-run PPP holds for Asian countries owing to flexible exchange rate systems and breaks down for South American countries due to long-time pegging to the dollar. Yotopoulos and Sawada (2006) reveal that PPP holds for 132 countries in a 20-year time period and for 105 countries in a 10-year time period. Applying the KSS (Kapetanios, Shin, and Snell, 2003) unit root test and based on a sample of 13 countries including Costa Rica, Francis and Iyare (2006) find that real exchange rates in most countries are nonlinear and stationary and that nominal exchange rates and relative prices are cointegrated.

Using a sample of 30 LDCs including Costa Rica, Holmes (2006) shows that 16 out of 30 countries exhibit nonlinearity in the real exchange rate. Based on a sample of 88 LDCs including Costa Rica and a new unit root test (KSS, 2003), Bahmani-Oskooee, Kutan and Zhou (2008) reveal that the number of countries that PPP holds are doubled, that there is nonlinear adjustment toward PPP in LDCs, and that PPP is more likely to hold for countries with relatively high exchange rate flexibility and high inflation. Alba and Papell (2007) indicate that PPP is valid for Latin American and European panel data, but not for Asian and African panel data. They also found stronger evidence of PPP for countries with more openness, lower inflation rates, moderate volatility of exchange rates, similar rates of economic growth as the U.S., and less distance from the U.S. Taylor and Taylor (2004) and Taylor (2006) review major previous works, present issues and challenges in verifying PPP, and maintain that long-run PPP has gained more support as the gap between theory and data and the deviation of exchange rates from PPP have narrowed.

Chinn (1999) reveals that the five Asian currencies under study are consistent with the specifications of some types of monetary models, that exchange rates do most of the adjustments toward equilibrium except for the New Taiwan dollar and the Thai baht, and that out-of-sample forecasts work well for the Korean won, the New Taiwan dollar, and the Singapore dollar. In another study, Chinn (2000) uses different models to evaluate currency overvaluation for several Asian currencies. As of May 1997, the PPP model shows that the Malaysian ringgit, the Thai baht, the Hong Kong dollar, and the Philippine peso were overvalued. A monetary model reveals that the Indonesian rupiah and the Thai baht are overvalued whereas the New Taiwan dollar, the Korean won, and the Singapore dollar are undervalued.

Applying an extended Mundell-Fleming model, Hsing (2005) finds that the real exchange rate in Slovakia is positively influenced by deficit spending/GDP ratio and the stock price index and negatively associated with real M2, the US Treasury bill rate, country risk, and the expected inflation rate. The error variance can be characterized by the GARCH process. Hsing (2007) shows that the US dollar/kuna exchange rate for Croatia is negatively associated with real M1, the US T-bond rate, the euro interest rate, the expected inflation rate, and the relative price and positively influenced by the expected exchange rate. Deficit spending does not affect the exchange rate. Most of the variation in exchange rates can be explained by the open economy model and uncovered interest-rate parity.

THE MODEL

This section presents four exchange rate models, namely, the purchasing power parity model, the uncovered interest parity model, the monetary models, and the Mundell-Fleming model.

The Purchasing Power Parity Model

In the purchasing power parity (PPP) model, the nominal exchange rate is a function of the relative price:

$$E = F(P / P^*) \tag{1}$$

where E, P, and P^* denote the CRC/USD exchange rate, the price level in Costa Rica, and the price level in the U.S. The sign of the relative price in equation (1) is expected to be positive, suggesting that a higher relative price would cause the CRC/USD exchange rate to rise or the Costa Rica Colon to depreciate against the U.S. dollar.

The Uncovered Interest Parity Model

In the uncovered interest parity (UIP) model, under the assumption of perfect capital mobility, the interest rate differential can be offset by the exchange rate depreciation or appreciation. If the domestic interest rate is greater than the foreign interest rate, then the domestic currency is expected to depreciate by the same magnitude. If the domestic interest rate is less than the foreign interest rate, then the domestic currency is expected to appreciate by the same magnitude. The UIP model can be expressed as

$$R = R^* + (E^e - E) / E \tag{2}$$

where R, R^*, and E^e stand for the interest rate in Costa Rica, the interest rate in the U.S., and the expected exchange rate. Expanding the second term on the right-hand side and moving E to the left-hand side and other terms to the right-hand side in equation (2), in general form, the nominal exchange rate is a function of the interest rate differential and the expected exchange rate:

$$E = H(R - R^*, E^e) \tag{3}$$

The sign of the interest rate differential is expected to be negative, and the sign of the expected exchange rate is expected to be positive, suggesting that when the interest rate differential rises, the Costa Rica Colon would appreciate against the U.S. dollar.

The Monetary Models

Several versions of the monetary models include:

$$E = V(M - M^*, Y - Y^*, R - R^*) \tag{4}$$

$$E = V(M - M^*, Y - Y^*, \pi^e - \pi^{e^*}) \tag{5}$$

$$E = V(M - M^*, Y - Y^*, R - R^*, \pi^e - \pi^{e^*}) \tag{6}$$

where M, Y, π^e, M^*, Y^*, and π^{e^*} denote money supply in Costa Rica, real GDP in Costa Rica, the expected inflation rate in Costa Rica, money supply in the U.S., real GDP in the U.S., and the expected inflation rate in the U.S.

Equation (4) describes the Dornbusch model and the Bilson model. The sign of the relative interest rate is negative in the Dornbusch model and positive in the Bilson model. Equation (5) illustrates the Frenkel model. The sign of the expected inflation rate is positive. In the Frankel model in equation (6), the nominal exchange rate is expected to have a positive relationship with the relative money supply and the relative expected inflation rate and a negative relationship with the relative output and the relative interest rate.

The Mundell-Fleming Model

Extending Romer (2001), we can express the equilibrium in the goods market and the money market as:

$$Y = Z(Y, R-\pi^e, G, T, \varepsilon) \tag{7}$$

$$M / P = L(Y, R, R^*, \varepsilon) \tag{8}$$

where ε, G, T, L, and R^* are the real exchange rate, real government spending, real government taxes, the demand for money, and the world interest rate. Solving for Y and ε, we have the equilibrium real exchange rate as:

$$\bar{\varepsilon} = f(M/P, G, T, R, R^*, \pi^e) \tag{9}$$

The respective impacts of a change in real money supply, real government deficit spending, the domestic interest rate, and the world interest rate on the equilibrium real exchange rate can be written by:

$$\partial\bar{\varepsilon} / \partial(M/P) = -(1-Z_Y)/|J| > 0, \tag{10}$$

$$\partial\bar{\varepsilon} / \partial(G-T) = (Z_G + Z_T)L_Y / |J| < 0, \tag{11}$$

$$\partial\bar{\varepsilon} / \partial R = [L_R(1-Z_Y) + L_Y Z_R]/|J| > 0, \tag{12}$$

$$\partial\bar{\varepsilon} / \partial R^* = L_{R^*}(1-Z_Y)/|J| < 0 \, if \, L_{R^*} > 0 \, or > 0 \, if \, L_{R^*} < 0, \tag{13}$$

where $|J|$ is the endogenous-variable Jacobian with a negative value, assuming that L_ε is positive. Thus, the equilibrium real exchange rate is expected to have a positive relationship with real money supply and the domestic interest rate and a negative relationship with real government deficit spending.

THE DATA

The data were collected from the *International Financial Statistics* published by the International Monetary fund. The nominal exchange rate is measured as Costa Rica Colon per U.S. dollar. In estimating the PPP model, the relative consumer price index (CPI) and the relative produce price index (PPI) are both considered. In estimating the UIP model, the deposit rates in Costa Rica and the U.S. are used to measure the interest rate differential because the money market rate or the Treasury bill rate for Costa Rica is not available. The lagged exchange rate is chosen to represent the expected exchange rate. In estimating the monetary models, M2 money, real GDP, the deposit rate, and the lagged inflation rate for both Costa Rica and the U.S. are used. In estimating the Mundell-Fleming model, the real exchange rate, real M2, the domestic deposit rate, the U.S. deposit rate, and the lagged inflation rate are used.

Government spending and tax revenues are not included due to lack of complete data. The consumer price index is used to derive real M2. Nominal M2 and real M2 are measured in billion colons for Costa Rica and billion dollars for the U.S. Real GDP is measured in million colons for Costa Rica and billion dollars for the U.S. The log scale is used except for variables with negative values.

Monthly data are used for the PPP and UIP models where quarterly data are used for the monetary and Mundell-Fleming models because the data for real GDP are available on a quarterly or yearly basis. The sample ranges from 1981.M1 to 2007.M9 for the PPP model, 1982.M1 to 2007.M8 for the UPI model, 2000.Q1 or 2000.Q2 to 2007.Q2 for the monetary models, and 2000.Q2 to 2007.Q2 for the Mundell-Fleming model. Different periods and data frequencies are used in order to increase the sample size. The monthly data have 321 observations for the PPP model and 308 observations for the UIP model. If quarterly data during 2000.Q2 – 2007.Q2 were used to test the PPP or the UIP, there would be only 29 observations in the sample.

EMPIRICAL RESULTS

Unit root tests in Table 1 show that all the variables are stationary in the first difference form. The cointegration test reveals that the variables in each of the four models are cointegrated and have a stable long-term relationship.

Table 1: Elliott-Rothenberg-Stock Unit Root Test

Variable	Test Statistic in Level Form	Test Statistic in First Difference Form
Log E	3.088	16.496
Log CPI/CPI*	1862.072	5.253
Log PPI/PPI*	447.058	2.715
Log R-Log R*	5.038	3.296
Log E*	12.682	13.522
Log M – Log M*	337.447	1.969
Log Y-Log Y*	597.498	70.911
$\pi^e - \pi^{e*}$	3.50	4.860
Log ε	11.708	3.760
Log M/P	225.781	2.156
*Log R**	5.144	4.073
π^e	4.174	11.554

Critical values: 1.87, 2.97, and 3.91 at the 1%, 5%, and 10% level respectively. This table shows the results of tests for the unit root for each of the variables. Values of the test statistic in the level and first difference forms are compared with the critical values at different significance levels.

Estimated regressions and related statistics are presented in Tables 2. Figures in the parenthesis are t-statistics. The Newey-West method is applied in empirical work to correct for both autocorrelation and heteroskedasticity when their forms are unknown. In the PPP model, both regressions have relatively high explanatory power, and the coefficient of the relative CPI or PPI is significant at the 1% level. The Wald test shows that the null hypothesis that the coefficient of the relative price measured either by the CPI or the PPI is equal to one cannot be rejected at the 5% level. The relative CPI seems to perform better in forecasting as the mean absolute percent error (MAPE) is calculated to be 3.927 compared with 4.589 when the relative PPI is used.

In the UIP model, 99.9% of the behavior of the exchange rate can be explained by the two right-hand side variables. Both of the coefficients are highly significant. The positive significant sign of the interest rate differential is opposite to the expected negative sign because a larger interest rate differential would cause the Costa Rica Colon to appreciate. The results may be due to a high degree of collinearity or the use of the lagged dependent variable as an explanatory variable. If the expected exchange rate is deleted from the regression, the coefficient of the interest rate differential is still positive and significant at the 1% level, and the value of R^2 declines to 17.6%. In the monetary models, the nominal exchange rate has a negative relationship with the relative money supply and the relative interest rate and is not affected by the relative real output and the relative inflation rate. The values of adjusted R^2 are relatively high. Empirical results suggest that the behavior of the exchange rate can be characterized by the Bilson model.

Table 2: Estimated Regressions for the Colon/USD Exchange Rate

Panel A: Purchasing Power Parity Model (Sample size = 321: 1981.M1-2007.M9)						
log E	**Intercept**	**log CPI/CPI***				
	5.725***	0.991***				Adj. R^2 = 0.995
	(789.651)	(73.669)				MAPE = 3.927
	Intercept	log PPI/PPI^*				
	5.727***	1.015***				Adj. R^2 = 0.994
	(706.635)	(67.730)				MAPE = 4.589
Panel B: Uncovered Interest Parity Model (Sample size = 308: 1982M.1-2007.M8)						
log E	**Intercept**	**log R-log R***	**log E^e**			
	0.017***	0.004***	0.997***			Adj. R^2 = 0.999
	(3.863)	(3.017)	(1168.194)			MAPE = 5.427
Panel C: Monetary Models (Sample size = 30 for Version A: 2000.Q1-2007.Q2; and 29 for Versions B and C: 2000.Q2-2007.Q2)						
log E	**Intercept**	**log M – log M^***	**log Y – log Y^***	**log R – log R^***	**π^e - π^{e*}**	
Eq. (4)	6.524***	0.579***	0.149	0.048***		Adj. R^2 = 0.988
	(136.143)	(17.846)	(0.760)	(6.601)		MAPE = 1.494
Eq. (5)	6.456***	0.554***	0.092		0.005	Adj. R^2 = 0.962
	(119.658)	(10.915)	(0.319)		(0.880)	MAPE = 2.549
Eq. (6)	6.511***	0.570***	0.181	0.047***	0.002	Adj. R^2 = 0.987
	(155.378)	(18.247)	(1.084)	(7.024)	(0.514)	MAPE = 1.509
Panel D: Mundell-Feming Model (Sample size = 29: 2000.Q2-2007.Q2)						
log ε	**Intercept**	**log M/P**	**log R**	**log R^***	**π^e**	
	4.670***	0.115***	0.092***	-0.027***	0.005	Adj. R^2 = 0.622
	(29.755)	(6.734)	(5.005)	(-4.903)	(1.570)	MAPE = 0.994

This table shows the estimated regressions for the purchasing power parity model in equation (1), the uncovered interest parity model in equation (3), the monetary models in equations (4), (5) and (6), and the Mundell-Fleming model in equation (9). ***, ** and * indicate significance at the 1, 5 and 10 percent levels, respectively.
E = the nominal exchange rate (colon per U.S. dollar),
CPI = the consumer price index in Costa Rica,
CPI^* = the consumer price index in the U.S.,
PPI = the producer price index in Costa Rica, and
PPI^* = the producer price index in the U.S.
R = the interest rate in Costa Rica,
R^* = the interest rate in the U.S., and
E^e = the expected exchange rate.
log E = log of the nominal exchange rate (colon per U.S. dollar),
log M – log M^* = log of nominal money supply in Costa Rica – log of nominal money supply in the U.S.,
log R – log R^* = log of the interest rate in Costa Rica – log of the interest rate in the U.S.,
log Y – log Y^* = log of real GDP in Costa Rica – log of real GDP in the U.S., and
ε= the real exchange rate,
M/P = real money supply in Costa Rica,
π^e = the expected inflation rate in Costa Rica.
π^e - π^{e*} = the expected inflation rate in Costa Rica – the expected inflation rate in the U.S.

In the Mundell-Fleming model, the value of adjusted R^2 is 62.2%. The real exchange rate has a positive relationship with real M2 and the domestic interest rate and a negative relationship with the world interest rate. These suggest that more real money supply or a higher domestic interest rate would cause the Costa Rica Colon to depreciate and that a higher world interest rate would cause the Costa Rica Colon to appreciate. Table 3 reestimates the regressions based on a common sample period of 2000.Q2-2007.Q2 with a total of 29 observations. Although the sample size is much smaller for the PPP model and the UIP model, the MAPE improves in these two models. The values of adjusted R^2 are relatively high. The estimated slope coefficients of the PPP model are slightly larger than those in Table 1. The estimated coefficient of the variable log R – log R^* in the UIP model is also larger than that in Table 1. Estimated results in Panels C and D are either very similar or identical because of the use of the same or similar sample size.

Table 3: Estimated Regressions for the Colon/USD Exchange Rate Based on the Same Sample Period of 2002.Q2-2007.Q2

Panel A: Purchasing Power Parity Model (Sample size = 29)						
log E	**Intercept**	**log CPI/CPI***				
	5.735***	1.056***				Adj. R^2 = 0.988
	(550.037)	(29.862)				MAPE = 1.499
	Intercept	log PPI/PPI*				
	5.720***	1.137***				Adj. R^2 = 0.970
	(353.753)	(19.179)				MAPE = 2.362
Panel B: Uncovered Interest Parity Model (Sample size = 29)						
log E	**Intercept**	**log R-log R***	**log E^e**			
	0.036	0.009***	0.995***			Adj. R^2 = 0.999
	(1.090)	(5.615)	(172.065)			MAPE = 0.638
Panel C: Monetary Models (Sample size = 29)						
log E	**Intercept**	**log M – log M***	**log Y – log Y***	**log R – log R***	**π^e - π^{e*}**	
Eq. (4)	6.515***	0.570***	0.186	0.047***		Adj. R^2 = 0.987
	(124.357)	(15.406)	(0.878)	(6.290)		MAPE = 1.520
Eq. (5)	6.456***	0.554***	0.092		0.005	Adj. R^2 = 0.962
	(119.658)	(10.915)	(0.319)		(0.880)	MAPE = 2.549
Eq. (6)	6.511***	0.570***	0.181	0.047***	0.002	Adj. R^2 = 0.987
	(155.378)	(18.247)	(1.084)	(7.024)	(0.514)	MAPE = 1.509
Panel D: Mundell-Feming Model (Sample size = 29)						
log ε	**Intercept**	**log M/P**	**log R**	**log R***	**π^e**	
	4.670***	0.115***	0.092***	-0.027***	0.005	Adj. R^2 = 0.622
	(29.755)	(6.734)	(5.005)	(-4.903)	(1.570)	MAPE = 0.994

This table shows the estimated regressions for the purchasing power parity model in equation (1), the uncovered interest parity model in equation (3), the monetary models in equations (4), (5) and (6), and the Mundell-Fleming model in equation (9). ***, ** and * indicate significance at the 1, 5 and 10 percent levels, respectively.
E = the nominal exchange rate (colon per U.S. dollar),
CPI = the consumer price index in Costa Rica,
CPI^* = the consumer price index in the U.S.,
PPI = the producer price index in Costa Rica,
PPI^* = the producer price index in the U.S.
R = the interest rate in Costa Rica,
R^* = the interest rate in the U.S., and
E^e = the expected exchange rate.
log E = log of the nominal exchange rate (colon per U.S. dollar),
log M – log M^* = log of nominal money supply in Costa Rica – log of nominal money supply in the U.S.,
log R – log R^* = log of the interest rate in Costa Rica – log of the interest rate in the U.S.,
log Y – log Y^* = log of real GDP in Costa Rica – log of real GDP in the U.S., and
ε= the real exchange rate,
M/P = real money supply in Costa Rica,
π^e = the expected inflation rate in Costa Rica and π^e - π^{e*} = the expected inflation rate in Costa Rica – the expected inflation rate in the U.S.

SUMMARY AND CONCLUSIONS

This paper has examined the behavior of the Costa Rica Colon exchange rate against the U.S. dollar. Four different models are considered in empirical work. The coefficient of the interest rate differential has a wrong sign in the uncovered interest parity model. Higher relative prices, higher interest rate differentials, and more money supply are expected to cause a weaker Colon against the U.S. dollar. Excluding the UIP model, the PPP model and monetary models have higher explanatory power than the Mundell-Fleming model. However, the Mundell-Fleming model performs the best in forecasting, followed by the Bilson model, the Frankel model, the Frenkel model, the PPP model with the relative CPI, and the PPP model with the relative PPI.

There may be areas for future research. The unexpected positive sign of the interest rate differential in the UIP model may suggest that more work needs to be done in the study of exchange rate movements for Costa Rica. The expected exchange rate plays a significant role in the determination of the exchange rate and may need to be constructed with more advanced methodologies.

REFERENCES

Alba, Joseph D. and David H. Papell (2007) "Purchasing Power Parity and Country Characteristics: Evidence from Panel Data Tests," *Journal of Development Economics*, vol. 83(1), May, p. 240-251.

Bahmani-Oskooee, Mohsen, Ali M. Kutan, Su Zhou (2008) "Do Real Exchange Rates Follow a Nonlinear Mean Reverting Process in Developing Countries?" *Southern Economic Journal*, vol. 74(4), April, p. 1049-1062.

Bilson, John F. O. (1978) "Rational Expectations and the Exchange Rate," in: J. Frenkel and H. Johnson, eds., *The Economics of Exchange Rates* (Addison-Wesley Press, Reading).

Breitung, Jorg and Bertrand Candelon (2005) "Purchasing Power Parity during Currency Crises: A Panel Unit RootTtest under Structural Breaks," *Review of World Economics/Weltwirtschaftliches Archiv*, vol. 141(1), 124-140.

Cheung, Yin-Wong, Menzie D. Chinn, and Antonio Garcia Pascual (2005) "Empirical Exchange Rate Models of the Nineties: Are Any Fit to Survive?" *Journal of International Money and Finance*, vol. 24(7), November, p. 1150-1175.

Chinn, Menzie D. (1999) "On the Won and Other East Asian Currencies," *International Journal of Finance and Economics*, vol. 4(2), April, p.113-127.

Chinn, Menzie D. (2000) "Before the Fall: Were East Asian Currencies Overvalued?" *Emerging Markets Review*, vol. 1(1), August, p. 101-126.

Chinn, Menzie D. and Guy and Meredith (2004) "Monetary Policy and Long-Horizon Uncovered Interest Parity," *IMF Staff Papers*, vol. 51(3), p. 409-430.

Dekle, Robert, Cheng Hsiao, and Siyan Wang (2002) "High Interest Rates and Exchange Rate Stabilization in Korea, Malaysia, and Thailand: An Empirical Investigation of the Traditional and Revisionist Views," *Review of International Economics*, vol. 10(1), February, p. 64-78.

Dornbusch, Rudiger (1976) "Expectations and Exchange Rate Dynamics," *Journal of Political Economy*, vol. 84(6), December, p. 1161-1176.

Francis, Brian and Sunday Iyare (2006) "Do Exchange Rates in Caribbean and Latin American Countries Exhibit Nonlinearities?" *Economics Bulletin,* vol. 6(14), 1-20.

Frankel, Jeffrey A. (1979) "On the Mark: A Theory of Floating Exchange Rates based on Real Interest differentials," *American Economic Review*, vol. 69(4), September, p. 610-622.

Frenkel, Jacob A. (1976) "A Monetary Approach to the Exchange Rate: Doctrinal Aspects and Empirical Evidence," *Scandinavian Journal of Economics*, vol. 78(2), p. 200-224.

Holmes, Mark J. (2006) Are There Non-Linearities in Real Exchange Rate Behavior? The Case of Less Developed Countries," in *International Macroeconomics: Recent Developments*, edited by Amalia Morales Zumaquero. New York: Nova Science Publishers.

Hsing, Yu (2005) "Analysis of Exchange Rate Fluctuations for Slovakia: Application of An Extended Mundell–Fleming Model," *Applied Financial Economics Letters*, 2005, vol. 1, 289–292

Hsing, Yu (2007) "Exchange Rate Fluctuations in Croatia: Test of Uncovered Interest Rate Parity and the Open Economy Model," *Applied Economics Letters*, 2007, vol. 14, 785–788

Jalbert, Terrance, Jonathan Stewart, and Mercedes Jalbert (2006) "Uncovered Interest Rate Arbitrage: A Test of the Efficiency of Costa Rica Deposit Accounts," *International Journal of Finance,* vol. 18(1), p. 3861-3887.

Kapetanios, George, Yongcheol Shin and Andy Snell (2003) "Testing for a Unit Root in the Nonlinear STAR Framework," *Journal of Econometrics,* vol. 112(2), 359-379.

Meese, Richard A. and Kenneth Rogoff (1983) "Empirical Exchange Rate Models of the Seventies: Do They Fit Out of Sample?" *Journal of International Economics*, vol. 14(1-2), February, p. 3-24.

Newey, Whitney K. and Kenneth D. West (1987) "A Simple, Positive Semi-Definite, Heteroskedasticity and Autocorrelation Consistent Covariance Matrix," *Econometrica*, vol. 55(3), May, p. 703-708.

Romer, David (2001) *Advanced Macroeconomics*, 2nd edition, New York: McGraw-Hill/Irwin

Taylor, Alan M. and Mark P. Taylor (2004) "The Purchasing Power Parity Debate," *Journal of Economic Perspectives*, vol. 18(4), Fall, p. 135-158.

Taylor, Mark P. (2006) "Real Exchange Rates and Purchasing Power Parity: Mean-Reversion in Economic Thought," *Applied Financial Economics*, vol. 16(1-2), January, p. 1-17.

Yotopoulos, Pan A. and Yasuyuki Sawada (2006) "Exchange Rate Misalignment: A New Test of Long-Run PPP Based on Cross-Country Data," *Applied Financial Economics*, vol. 16(-12), January, p. 127-134.

BIOGRAPHY

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