The uncovered interest parity puzzle, exchange rate forecasting, and Taylor rules

Charles Engel, Dohyeon Lee, Chang Liu, Chenxin Liu, Steve Pak Yeung Wu

Journal of International Money and Finance (2019)

Motivation

- Uncovered interest parity (UIP) puzzle

(1) $$E_t s_{t+1} - s_t = i_t^{US} - i_t^*$$

S_{t+1}: log of the dollar price of foreign currency at time t+1

i_t : one-period nominal interest rate in the U.S./foreign country

(2) $$s_{t+1} - s_t = a_0 + a_1(i_t^{US} - i_t^*) + \zeta_{t+1}$$

If UIP holds, we should find the estimate of a_1 is close to 1. But studies very often reject the null that a_1 =1, and less often find a_1 is significantly less than zero.

- Second puzzle: Taylor rule fundamentals help predict the change in the exchange rate, but in the opposite direction than would arise in a model in which UIP holds.

(3) $$i_t^{US} = \gamma_0^{US} + \gamma_1^{US}\pi_t^{US} + \gamma_2^{US}\tilde{y}_t^{US}$$

where π_t^{US} is the inflation rate in the U.S., and $\tilde{y}_t^{US}$ is the output gap in the U.S.

(4) $$i_t^* = \gamma_0^* + \gamma_1^*\pi_t^* + \gamma_2^*\tilde{y}_t^*$$

If uncovered interest parity, (1), held, we would have:

$$E_t s_{t+1} - s_t = \gamma_0^{US} + \gamma_1^{US}\pi_t^{US} + \gamma_2^{US}\tilde{y}_t^{US} - (\gamma_0^* + \gamma_1^*\pi_t^* + \gamma_2^*\tilde{y}_t^*).$$

For example, higher U.S. inflation should predict the dollar will depreciate. However, Molodtsova and Papell (MP) and others find the coefficient on U.S. inflation is negative and on foreign inflation is positive.

- Third puzzle: the Taylor-rule fundamentals do a better job of predicting the exchange rate change than does the relative interest rate differential. MP finds (7) is a better fit than (2).

(5) $$i_t^* = \gamma_0^* + \gamma_1^* \pi_t^* + \gamma_2^* \tilde{y}_t^* + u_t^* .$$

(6) $$i_t^{US} = \gamma_0^{US} + \gamma_1^{US} \pi_t^{US} + \gamma_2^{US} \tilde{y}_t^{US} + u_t^{US}$$

Here, u_t^{US} and u_t^* are exogenous random variables.

(2) $$s_{t+1} - s_t = a_0 + a_1 (i_t^{US} - i_t^*) + \zeta_{t+1}$$

(7) $$s_{t+1} - s_t = b_0 + b_1 \pi_t^{US} + b_2 \tilde{y}_t^{US} + b_3 \pi_t^* + b_4 \tilde{y}_t^* + \theta_{t+1},$$

: $b_0 = a_0 + a_1(\gamma_0^{US} - \gamma_0^*)$, $b_1 = a_1 \gamma_1^{US}$, $b_2 = a_1 \gamma_2^{US}$, $b_3 = -a_1 \gamma_1^*$, $b_4 = -a_1 \gamma_2^*$ and $\theta_{t+1} = \zeta_{t+1} + a_1(u_t^{US} - u_t^*)$.

(8) $$E_t s_{t+1} - s_t = a_0 + a_1 (i_t^{US} - i_t^*).$$

In-sample forecasting

- Data

Exchange rate : the end-of-month data from the Federal Reserve database, H.10 release

One-month interest rates: midpoint of bid and offer rates for one-month Eurocurrency rates, as reported on Intercapital from Datastream

Inflation rates: constructed from consumer price index from line 64 of the IFS

They begin the sample in January 1999, which corresponds with the advent of the euro, and use data through December 2015.

Results

UIP regression with inflation included. Specification 1 - UIP regression: $s_{t+1} - s_t = a_0 + a_1(i_t^{US} - i_t^*) + \zeta_{t+1}$. Specification 2 - UIP regression with inflation included: $s_{t+1} - s_t = b_0 + b^i(i_t^{US} - i_t^*) + b^{US}\pi_t^{US} + b^*\pi_t^* + \zeta_{t+1}$.

Country	Specification 1	Specification 2		
	$\hat{a}_1$	$\hat{b}^i$	$\hat{b}^{US}$	$\hat{b}^*$
Canada	0.08	2.05	-4.78^{*}	4.32
	(2.76)	(2.97)	(2.74)	(3.78)
Denmark	−0.76	−0.76	-4.92^{*}	2.30
	(1.95)	(1.95)	(2.50)	(3.74)
Euro zone	−1.96	4.30^{*}	-17.42^{***}	22.22^{***}
	(1.95)	(2.29)	(3.61)	(5.13)
Japan	0.51	0.54	−0.57	−1.78
	(1.11)	(1.34)	(2.13)	(2.28)
Norway	0.15	−0.16	-4.75^{**}	-5.95^{**}
	(1.50)	(1.52)	(2.14)	(2.56)
Switzerland	−1.71	−1.18	-8.69^{***}	9.79^{**}
	(1.86)	(1.98)	(3.15)	(4.40)
Sweden	−1.32	1.34	-9.62^{***}	5.87^{*}
	(1.64)	(1.95)	(2.93)	(3.26)
UK	0.45	−0.41	-4.34^{**}	−1.10
	(1.94)	(1.95)	(1.70)	(1.95)

Notes: The standard errors are reported in parenthesis. *, **, and *** indicate that the alternative model significantly different from zero at 10, 5, and 1% significance level, respectively, based on standard normal critical values for the two-sided test. Sample period are monthly data from January 1999 to December 2015 (204 observations).

Proposed solution: Dynamic model with 3 equations

(12) $i_t^R = \sigma \pi_t^R + u_t,\ u_t = \rho u_{t-1} + v_t;\ \sigma > 0,\ 0 < \rho < 1$

(13) $i_t^* + (E_t s_{t+1} - s_t) - i_t^{US} = \alpha(i_t^{US} - i_t^*) + \eta_t,\ \alpha > 0.$

$$E_t s_{t+1} - s_t = (1 + \alpha)(i_t^{US} - i_t^*) + \eta_t,$$

(14) $-(i_t^R - E_t \pi_{t+1}^R) + E_t q_{t+1} - q_t = \alpha i_t^R + \eta_t,\ \alpha > 0.$

$q_t = s_t - p_t^R$, and $\pi_{t+1}^R = p_{t+1}^R - p_t^R$

(15) $\pi_t^R = \delta(q_t - \bar{q}_t) + \beta E_t \pi_{t+1}^R,\ \delta > 0,\ 0 < \beta < 1.$

$$\bar{q}_t = \mu \bar{q}_{t-1} + \varepsilon_t,\ 0 < \mu < 1;$$

. $\bar{q}_t$ is an exogenously given "long-run" value for the real exchange rate

General solution to the model

$$i_t^R = \frac{-\sigma\delta(1-\mu)}{D_1}\bar{q}_t + \frac{(1-\rho)(1-\beta\rho)-\delta\rho}{D_2}u_t - \frac{\sigma\delta}{D_3}\eta_t$$

$$\pi_t^R = \frac{-\delta(1-\mu)}{D_1}\bar{q}_t - \frac{\delta(1+\alpha)}{D_2}u_t - \frac{\delta}{D_3}\eta_t$$

$$E_t s_{t+1} - s_t = \frac{-(1-\mu)\delta\sigma(1+\alpha)}{D_1}\bar{q}_t + \frac{(1+\alpha)[(1-\rho)(1-\beta\rho)-\rho\delta]}{D_2}u_t + \frac{1}{D_3}\eta_t.$$

$$q_t = \frac{\delta[\sigma(1+\alpha)-\mu]}{D_1}\bar{q}_t - \frac{(1+\alpha)(1-\beta\rho)}{D_2}u_t - \frac{1}{D_3}\eta_t,$$

where

$$D_1 = \delta[(1+\alpha)\sigma-\mu] + (1-\beta\mu)(1-\mu)$$

$$D_2 = \delta[(1+\alpha)\sigma-\rho] + (1-\beta\rho)(1-\rho)$$

$$D_3 = 1 + \sigma\delta(1+\alpha).$$

Thank you