

# Discussion for "Taylor Rules and the Euro" by Molodtsova, Nikolsko-Rzhevskyy, Papell

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# Where this paper belongs:

Recent research agenda that looks at:

- 1 The **asset-pricing approach** to exchange rate (ER), emphasizing **expectations**
- 2 ER models with a more appropriate modeling of monetary policy:  
**Taylor rule** (TR)

to which Molodtsova, Nikolsko-Rzhevskyy, Papell (MNRP), and a subset of them, have made significant contributions

# Outline:

- Clarify the question this paper tries to answer
- How it fits in the bigger picture
- Comments on selected main results in this paper
- Main lessons from this general literature
- Expectations and ER: an alternative proposal

- Many papers start with Meese-Rogoff (1983), but few nowadays are really about Meese-Rogoff
- Distinguishing two camps:
  - ① Meese-Rogoff in spirit: **testing ER models**; often use out-of-sample forecast performance relative to a RW as an evaluation
  - ② Meese-Rogoff-esque: (atheoretical) **forecast equations**; may use theory to loosely justify predictors, but goal is to improve upon a RW forecast
- 1 is very difficult: no consistent **model** has emerged, but *some* equation can forecasts ER better than RW over some period
- This paper belongs to 2, with thorough metrics and robustness checks

## Common Elements:

- Taylor Rules:  $i_t = \mu_t + \beta_y y_t^{gap} + \beta_\pi \pi_t^e$
- Relating interest rates to expected exchange rate changes
  - Risk-adjusted UIP:  $i_t - i_t^* = E_t \Delta s_{t+1} + \rho^H$
  - Forward Premium Puzzle (FPP): e.g.  $E_t \Delta s_{t+1} = -\omega(i_t - i_t^*)$ ; no theoretical guidance on value of  $\omega$
- Other common variations:
  - asymmetric? ( $q$  targeting?); homogeneous? ( $\beta = \beta^*$ ?); smoothing? ( $i_{t-1}$ ?)
  - Imposing Taylor Rule parameters? e.g.  $\beta_\pi = 1.5, \beta_y = 0.5$

# Comparisons of Recent Work

	Sample ER	Exp.	In/out of Smpl	UIP or FPP	TR Param?	Output Gap
Engel-West (2006)	<i>USD/DMK</i>	VAR	In	UIP	Impose Coeff	hp, quad detrended
EMW (2007)	Panel	Surveyed data	various	UIP	Impose Coeff	
Chinn (2008)	USD/EUR	NA	In	FPP	No	hp, BP, linear
MP (2009)	Panel	NA	Out	FPP	No	Hp, judgment
MNRP (2008)	USD/DMK	Surveyed data	Out	FPP	Estimated w/ RT Data	
<b>MNRP(2009)</b>	<b>USD/EUR</b>	<b>Surveyed data</b>	<b>Out</b>	<b>FPP</b>	<b>No</b>	<b>HP, OECD, Unempl</b>

- Leaving out e.g. Mark (2007) on USD/DMK with learning; Wang and Wu (2009) on interval forecast...etc.

## 1. Perhaps unnecessarily atheoretical?

- All the theoretical parameter values are relaxed via FPP:

$$E_t \Delta s_{t+1} = -\omega(i_t - i_t^*)$$

- Good that positive results confirm previous studies, but can do more here? e.g.
- NOT testing model anyway, so search over a wider set of variables? (Chinn et al 2005)
- Push more on theory by looking more into FPP?
- e.g. Impose TR parameter values, as in Fig. 2, to get a sense of  $\omega$
- Can observe how  $\hat{\omega}$  changes over time (corresponding to Fig 5)
- Compare short- vs. long-horizon predictions, do  $\hat{\omega} \rightarrow -1$ ; UIP in LR?



## 2. Specification successful in MNRP (JME 2009) for DMK **no longer successful** in MNRP (2009) for Euro

- "results consistent with the view that, like the Fed but unlike the Bundesbank, the ECB does not put much weight on the exchange rate when setting interest rate"
- but also consistent with wide-spread parameter instabilities observed in broader forecasting literature (Stock and Watson 1996, Bachatta & van Wincoop...)
- For a forecasting equation, good to get a sense of the relevance and the source of instability
- e.g.  $\Delta$ policy?  $\Delta\omega$ ? Statistical?

3. When  $i \uparrow$ , what happens to ER, contemporaneously and subsequently?
- Empirically: ER **appreciates both** contemporaneously and subsequently
  - Theory/Model:  $i \uparrow$  (e.g in response to  $\pi \uparrow$ ,  $y \uparrow$ ) contemporaneous **appreciation**, but subsequent **depreciation**
  - Flip the sign using empirical "FPP":  $E_t \Delta s_{t+1} = -\omega(i_t - i_t^*)$
  - e.g. INVESTOR MISPERCEPTION re: the persistence of interest rate shock (Gourinchas and Tornell 2004)
  - In current context: a bit too astructural. No guidance on dynamics? Consistency CB's a simple Taylor rule?
  - Risk premium (e.g. Engel-West 2006, Chen-Tsang 2009...)?

4. "We **did not update the data through 2008** because of the zero bound on the nominal interest rate. Once the Federal Funds rate approaches zero, it cannot be lowered further and future interest rate setting cannot be predicted by the Taylor rule"

- True, but maybe inflation and output expectation should still matter?
- 6 more data points; at least document the breakdown?

5. Specifications using **forecasted inflation**, and four-quarter-ahead **output gap or unemployment forecasts**, depict the **strongest results** in the paper" (p. 20 and Table 6)

- Explored more? (especially since this is a new message)
- clarification: did subsequent Table 7 and Fig 5 back to real-time data?
- Since we are looking for forecasting equation, why not include both? (real time and forecasted)?
- Possibly consistent with the investor misperception story? (systematic under-estimation of the persistence of  $i$ )

- **Exchange rate models are not as bad as you think**
  - ER is not as disconnected with fundamentals, and model evaluation doesn't have to involve beating RW
- **For forecasting, beating the RW is not as difficult as you think**
  - For out-of-sample forecasts: can search for optimal set of predictors and specifications
  - Key: can we stay relatively close to the models?
- **Exchange rate depends on what you think: Expectations matter!**
  - VAR forecasts? poor measure of market expectations
  - Surveyed forecasts? some evidence, but ...
  - Exploit information in the yield curves: Chen-Tsang (2009a, b)
- However, **exchange rate puzzles are not quite as resolved as you may think** (i.e. FPP, delayed overshooting)

- Exchange Rate = NPV of expected future macro fundamentals
- Macro-finance literature: the shape of the yield curve contains information about market expectation on future macro fundamentals
- To summarize information in the yield curve effectively: Nelson-Siegel (1987) factors
- For exchange rates: look at the *relative* N-S factors between two countries
- Result: work well and offer an intuitive explanation for FPP

# Consistent with both Monetary and the Taylor Rule Models

e.g. TR-based model:

- TR at home:  $i_t = \mu_t + \beta_y y_t^{gap} + \beta_\pi \pi_t^e$
- TR abroad:  $i_t^* = \mu_t^* + \beta_y y_t^{*,gap} + \beta_\pi \pi_t^{*e} - \delta q_t$  where  $q_t = s_t - p_t + p_t^*$
- Risk-adjusted UIP:  $i_t - i_t^* = E_t \Delta s_{t+1} + \rho^H$
- $\implies s_t = \gamma f_t^{TR} + \psi E_t s_{t+1}$  (solve forward the first difference)
- 

$$\Delta s_t = \lambda \sum_{j=1}^{\infty} \psi^j E_t (\Delta f_{t+j}^{TR} | I_t)$$

$$f_t^{TR} = \{(y_t - y_t^*), (\pi_t^e - \pi_t^{*e}), (p_t - p_t^*), \rho^H\}$$

- use the **yield curves** to proxy the discounted sum:  $\sum_{j=1}^{\infty} \psi^j E_t (\Delta f_{t+j} | I_t)$

# Summarizing Yield Curves w/ Nelson-Siegel (1987) Factors

For each  $t$ : look at  $i_t^m$  over  $m$ :

$$i_t^m = L_t + S_t \left( \frac{1 - e^{-\lambda m}}{\lambda m} \right) + C_t \left( \frac{1 - e^{-\lambda m}}{\lambda m} - e^{-\lambda m} \right)$$

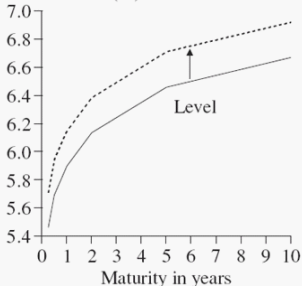
- **Level**  $L_t$ : loading on 1  $\rightarrow$  shifts the whole yield curve
- **Slope**  $S_t$  (term spread): loading starts from 1 and decreasing  $\rightarrow$  moves short end of the yield curve
- **Curvature**  $C_t$ : loading increases and then drops  $\rightarrow$  moves middle part of the yield curve
- $\lambda = 0.0609$ ; Empirical fit  $\approx 0.99$ , an effective way to summarize the curve



## Effects of level, slope, and curvature on yield curve

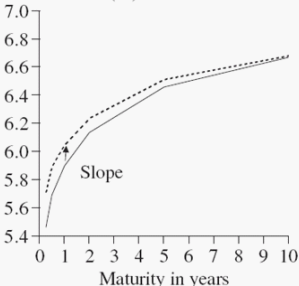
### A. Level

Interest rates (%)



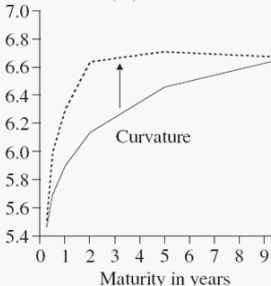
### B. Slope

Interest rates (%)



### C. Curvature

Interest rates (%)



# What do these YC factors tell us?

**Extensive** macro-finance literature links these factors to expected future economic activity.e.g.

- Level factor  $L_t$  captures expected longer-run inflation
  - Mishkin (1990), Barr and Campbell (1997), Dewachter and Lyrio Rud(2006), Rudebusch and Wu (2007)...
  - A **higher level indicates higher expected long run inflation**
- Slope factor  $S_t$  forecasts GDP growth, recession, monetary policy...
  - Estrella and Mishkin (1996), Hamilton and Kim (2002), Ang, Piazzesi and Wei (2006), Rudesbusch and Wu (2008)...
  - A **flatter slope reflects expected GDP slowdown**

## For ER: use *relative* Nelson-Siegel factors

- ER is a relative price reflecting the cross-country differences in fundamentals and their expectations
- Look at yield curve *differences* across countries to extract *relative* factors  $L_t^R, S_t^R, C_t^R$  to proxy for NPV
- Can further ask: do expectations, as captured in the factors, affect **currency risk premium?**

$$rx_{t+m} = i_t^{m*} - i_t^m + \Delta s_{t+m}$$

- Predictive regressions at various horizons (1 quarter to 2 years):

$$\begin{aligned} 1200 \frac{(s_{t+m} - s_t)}{m} &= \beta_{0,m} + \beta_{Lm} L_t^R + \beta_{Sm} S_t^R + \beta_{Cm} C_t^R + \varepsilon_{t+m} \\ rx_{t+m} &= \delta_{0,m} + \delta_{Lm} L_t^R + \delta_{Sm} S_t^R + \delta_{Cm} C_t^R + v_{t+m} \end{aligned}$$

# The Yield Curves Tell Us A LOT about the Exchange Rates

Using monthly data for the US, Canada, Japan and the UK over 1985-2005,

we find that the yield curves can predict exchange rate changes and excess currency returns

- In-sample: predictability for 1-month to 2-year ahead
- Out-of-sample: outperform random walk in 1 and 2 months-ahead forecasts

A 1% point rise in the overall level of the yield curve, or flattening of its slope, *ceteris paribus*,

- leads to a 3-4% appreciation of the currency subsequently (size of response declines as horizon increases)
- and a significant (and larger) raise the currency risk premium

## Non-Overlapping Data (ER Change)

$$\frac{1200(s_{t+m} - s_t)}{m} = \beta_{m,0} + \beta_{m,1}L_t^R + \beta_{m,2}S_t^R + \beta_{m,3}C_t^R + u_{t+m}$$

	m=3	m=6	m=3	m=6	m=3	m=6
	Canada		Japan		UK	
<b>L<sup>R</sup></b>	<b>-3.220*</b>	-1.702	-2.153	0.060	<b>-4.666*</b>	<b>-2.669*</b>
	(1.357)	(1.393)	(2.982)	(2.975)	(1.890)	(1.176)
<b>S<sup>R</sup></b>	-0.550	-0.642	<b>-3.494*</b>	<b>-4.226*</b>	<b>-2.308*</b>	<b>-2.080*</b>
	(0.521)	(0.425)	(1.693)	(1.816)	(0.943)	(0.674)
<b>C<sup>R</sup></b>	<b>-0.794*</b>	<b>-0.791*</b>	0.503	1.024	<b>-1.240*</b>	<b>-0.831*</b>
	(0.443)	(0.442)	(1.258)	(1.255)	(0.563)	(0.325)
<b>N. obs.</b>	79	39	79	39	71	35
<b>Adj. R<sup>2</sup></b>	0.029	0.020	0.029	0.067	0.092	0.194

## Excess Currency Return (GBP-USD)

$$rx_{t+m} = \gamma_{m,0} + \gamma_{m,1}L_t^R + \gamma_{m,2}S_t^R + \gamma_{m,3}C_t^R + v_{t+m}$$

	m=3	m=6	m=12	m=18	m=24
$L^R$	-4.858*	-4.451*	-3.718*	-3.086*	-2.534*
$t/\sqrt{m}$	-1.959	-2.446	-2.507	-2.134	-1.821
$S^R$	-3.772*	-2.824*	-2.138*	-1.727*	-1.397*
$t/\sqrt{m}$	-1.926	-2.377	-2.530	-2.249	-1.888
$C^R$	-0.939	-1.229*	-1.039*	-0.906*	-0.718*
$t/\sqrt{m}$	-0.994	-2.135	-2.363	-2.157	-1.766
<b>N. obs.</b>	108	159	195	198	192

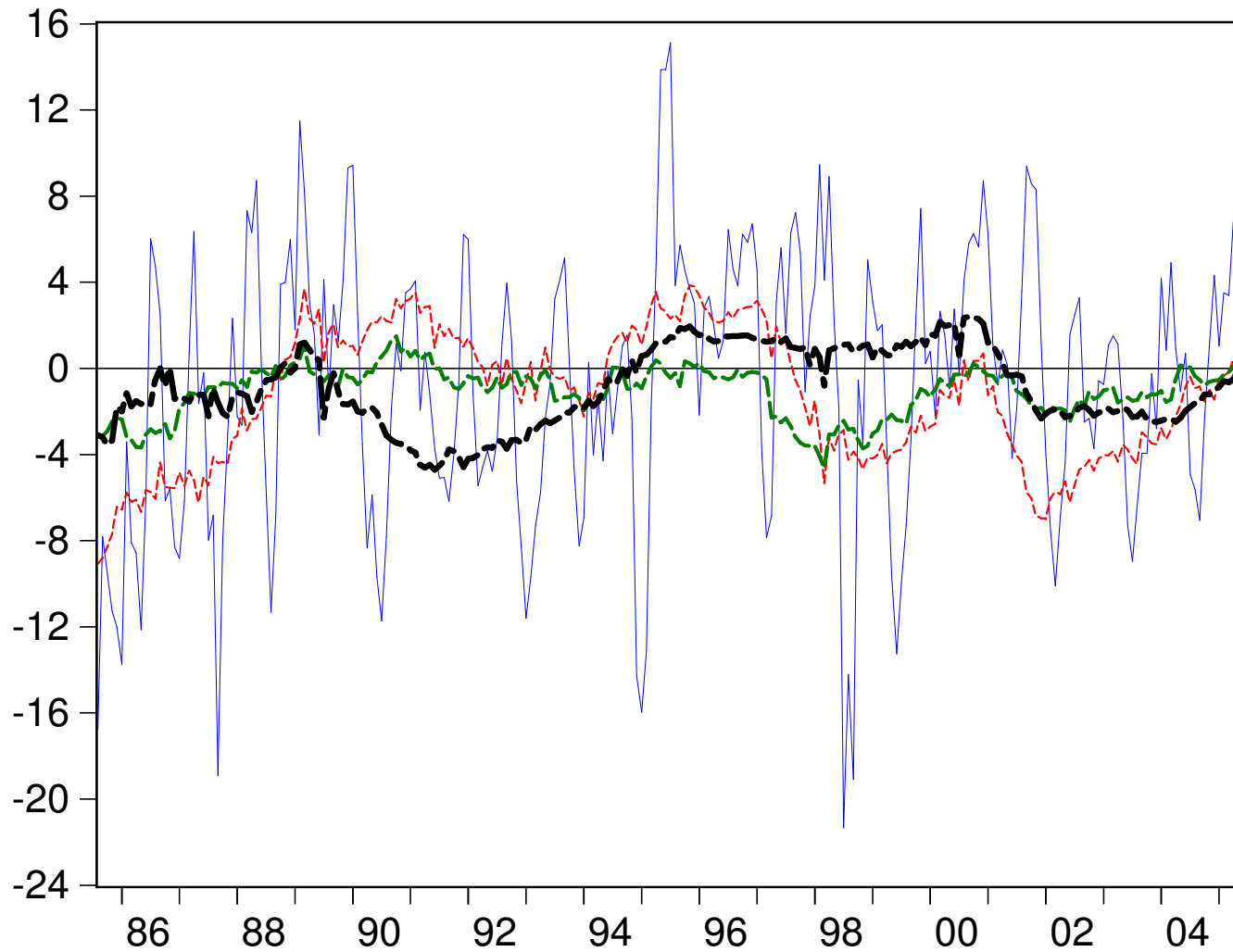
# Results help explain the UIP Puzzle

Risk-adjusted UIP:

$$\Delta s_{t+1} = i_t - i_t^* - \rho_{t+1}^H + \epsilon_{t+1}$$

Why might high  $i_t$  be associated with low  $\Delta s_{t+1}$  (subsequent appreciation)?

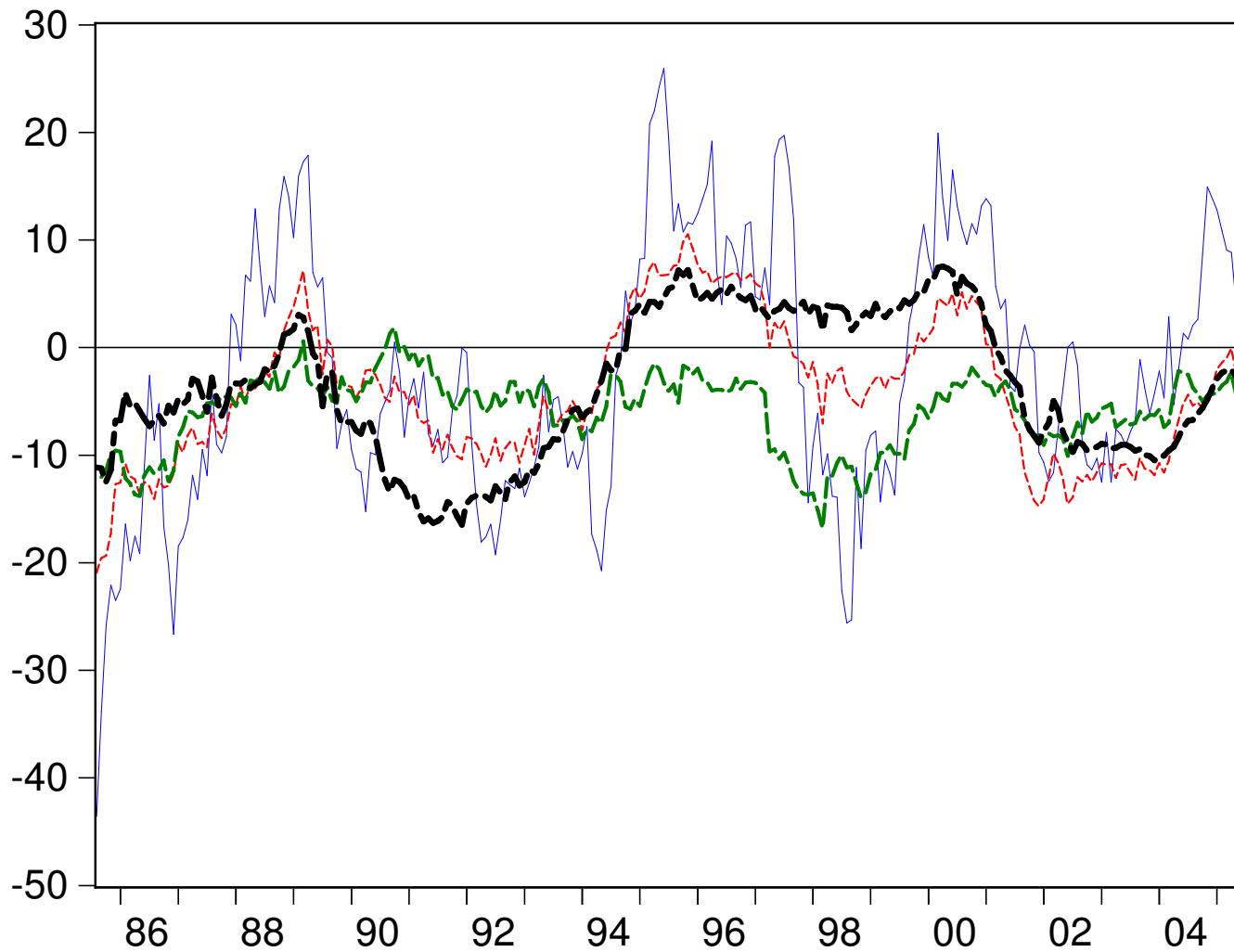
- $i_t \uparrow$  will either raise  $L_t^R$  or  $S_t^R$ , or both
- $\rho^H \uparrow$ , due to the high expected inflation and/or output slowdown
- Large risk premium response  $\implies \Delta s_{t+m} \downarrow$



— 3-Month Exchange Rate Change  
- - - Fitted Value (Macro + Yields)  
- - - Fitted Value (Macro)  
- - - Fitted Value (Yields)

Macro+Yields RMSE: 6.027  
Macro RMSE: 6.052  
Yields RMSE: 5.930  
RW RMSE: 6.207





— 12-Month Exchange Rate Change  
- - - Fitted Value (Macro + Yields)  
- - - Fitted Value (Macro)  
- - - Fitted Value (Yields)

Macro+Yields RMSE: 8.331  
Macro RMSE: 10.979  
Yields RMSE: 9.730  
RW RMSE: 11.766

- Exchange rates are NOT disconnected from macro fundamentals
- e.g. MP (2008), MNRP (2009a, 2009b) offer important new insights on ER forecastability using Taylor-rule fundamentals and real time data
- "What I want, what I really really want" to see: more on FPP and more on expectations