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What to do when effective exchange rates cannot be calculated for developing countries? PANIC?

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Motivation

- This study is devoted to practitioners who are focusing on **developing countries economic modelling** for which **EER is not available.**

- Table 1-Missing info after merging 3 sources : Bank for International Settlements (BIS), the International Monetary Fund (IMF), the Organisation for Economic Co-operation and Development (OECD).

- The EER determines the value of a currency relative to a basket of *N* other major currencies (the N main trading partners). EER=trade-weighted currency index:

$$\mathrm{EER} = \sum_{i=1}^{N} \omega_i \mathrm{fx}_i$$

where ω_i the trade allocation of each partner (= trade volume of partner i / total trade)

Table 1. Developing countries for which EER is not provided.

Albania	Kenya	Republic of Moldova
Angola	Kiribati	Rwanda
Azerbaijan	Kuwait	São Tomé and Príncipe
Bangladesh	Kyrgyzstan	Senegal
Belarus	Lebanon	Serbia
Benin	Liberia	Seychelles
Bosnia and Herzegovina	Libya	Singapore
Botswana	Madagascar	Somalia
Brunei Darussalam	Maldives	Sri Lanka
Burkina Faso	Mali	Sudan
Cabo Verde	Marshall Islands	Suriname
Chad	Mauritania	Syrian Arab Repuplic
Comoros	Mauritius	Taiwan Province of China
Cuba	Federated States of Micronesia	Tajikistan
Djibouti	Montenegro	Timor-Leste
Egypt	Mozambique	Tonga
Eritrea	Myanmar	Turkmenistan
Ethiopia	Namibia	Tuvalu
Guinea	Nauru	United Republic of Tanzania
Guinea-Bissau	Nepal	Uzbekistan
Haiti	Niger	Vanuatu
Iraq	Oman	Viet Nam
Jordan	Palau	Zimbabwe
Kazakhstan	Qatar	

Objective

- We propose to extract an **effective exchange rate** (EER) proxy using a **factor model.**
- We apply the **Panel Analysis of Non-stationarity in Idiosyncratic and Common components** methodology proposed by Bai and Ng (2004).

The intuition

- The **Common trend** of the value of a currency against the trading partner's currency is driven by the money **supply-demand forces**

  (incl. Trading activity, financial capital flow …).

  $\Rightarrow$The **common trend** ~ EER (if there is no institutional constraints, *i.e.* FX control).

One-factor model framework

$$X_{it} = c_{it} + \beta_i F_t + \varepsilon_{it} \qquad (1)$$

$$(1-L)F_t = u_t$$

$$for\ t = 1,\dots,T\ and\ i = 1,\dots,N.$$

- X_{it} are **observable** at t,
- F_t~ I(1), the (unique) **factor (unobserved)**,
- β_i is the vector of factor loadings,
- ε_{it} are the **idiosyncratic** components **(unobserved)**, uncorrelated at all leads and lags with the common factor - can be I(1) or I(0).

Estimation and testing for non-stationarity

- **If idiosyncratic components are I(0),** then the factor can be consistently estimated directly from the previous system in level (as X_{it} and F_t cointegrate together)

- **If idiosyncratic components are I(1),** Bai and Ng (2004) show that consistent estimates for both unobserved components can always be obtained by estimating the 1rst order difference of equation (1).

  $\Rightarrow$ the cumulative sums of $\Delta\hat{F}_t$ and $\Delta\hat{\varepsilon}_{it}$ are consistent estimator for F_t and ε_{it} .

Estimation and testing for non-stationarity

- Model for exchange rate returns coincides with 1rst order difference model:

$$\Delta X_{it} = \beta_i \, \Delta F_t + \Delta\varepsilon_{it}$$

with $\Delta X_{it} = \ln(X_{it}/X_{it-1})$.

Principal components analysis (PCA) can be applied to ΔX_{it} to obtain $\Delta \hat{F}_t$ and $\Delta \hat{\varepsilon}_{it}$, **regardless of their dynamic**.

- Idiosyncratic stationarity is tested using a pooled unit root test

H_0: *idiosyncratic processes all have a unit root*

- Non-stationarity of the factor can be tested using an ADF test regardless the stationarity property of the idiosyncratic terms.

Selecting the basket of foreign currencies

- We use **sparse principal component analysis** (*Zou, Hastie, and Tibshirani, 2006*) instead of PCA in the procedure
- SPCA~least absolute shrinkage and selection operator (LASSO):

$$\min_{a,\beta} \sum_{t=1}^{T} \left\| X_t - a\beta' X_t \right\|^2 + \kappa \left\| \beta \right\|,$$

$$subject\, to\; a'a = 1.$$

- κ>0 is the tuning parameter: for a large values taken, some loadings will shrinck to exact zero.

Empirical results

- BRICS' exchange rates.
- Sample: From January 1999 to April 2017. Frequency: Monthly.
- Sparsity level selection (*i.e.* choice of κ): Bayes information criterion (BIC) - see *Leng and Wang (2009)*.

Figure 1a. Bilateral exchange rates for 12 selected trading partners for China, from January 1999 to April 2017.

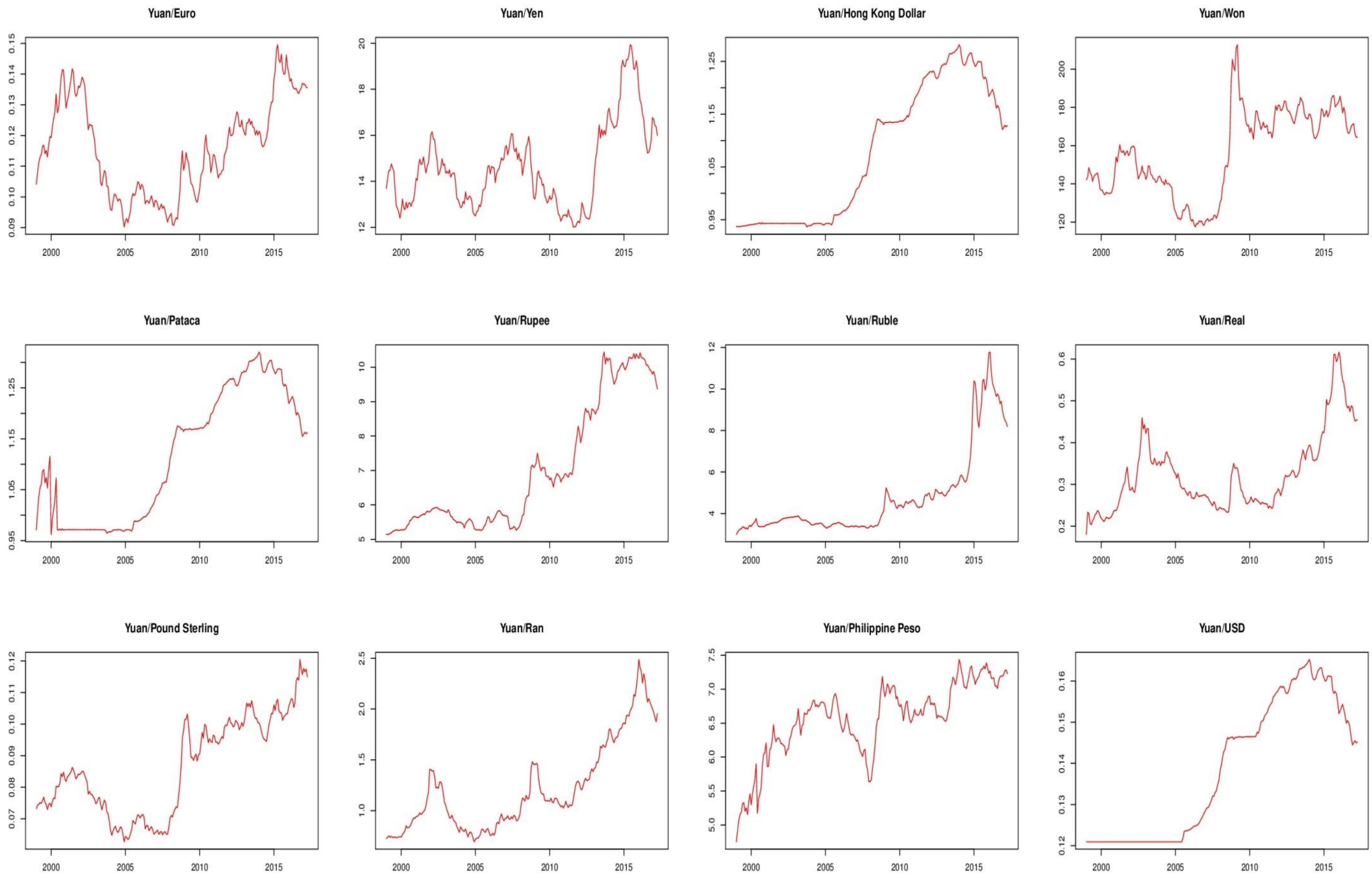

Figure 1b. Bilateral exchange rate returns calculated as $\log(x_t/x_{t-1})$.

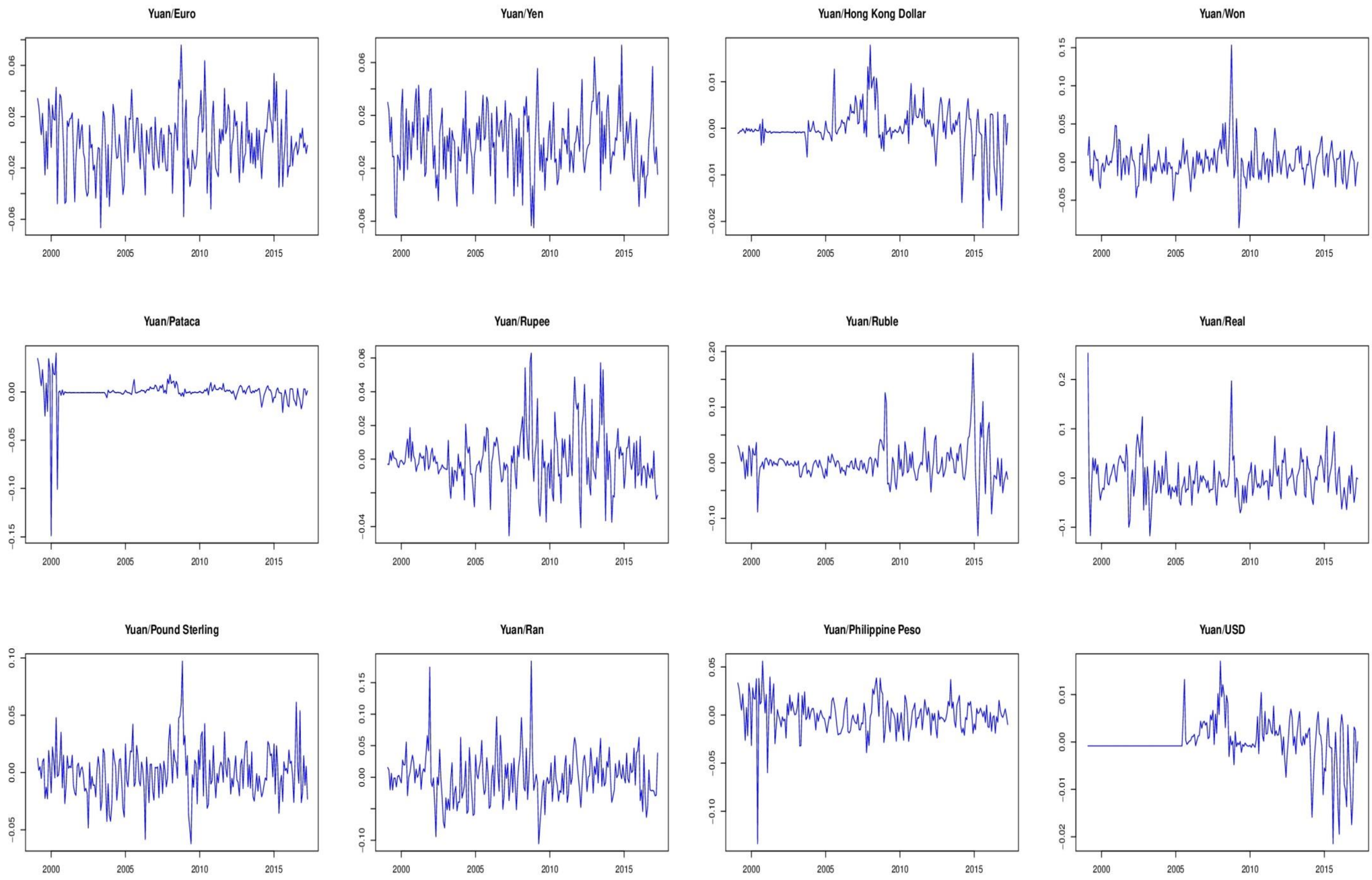

Figure 2a. Effective exchange rate returns Vs factor for the Chinese Yuan.

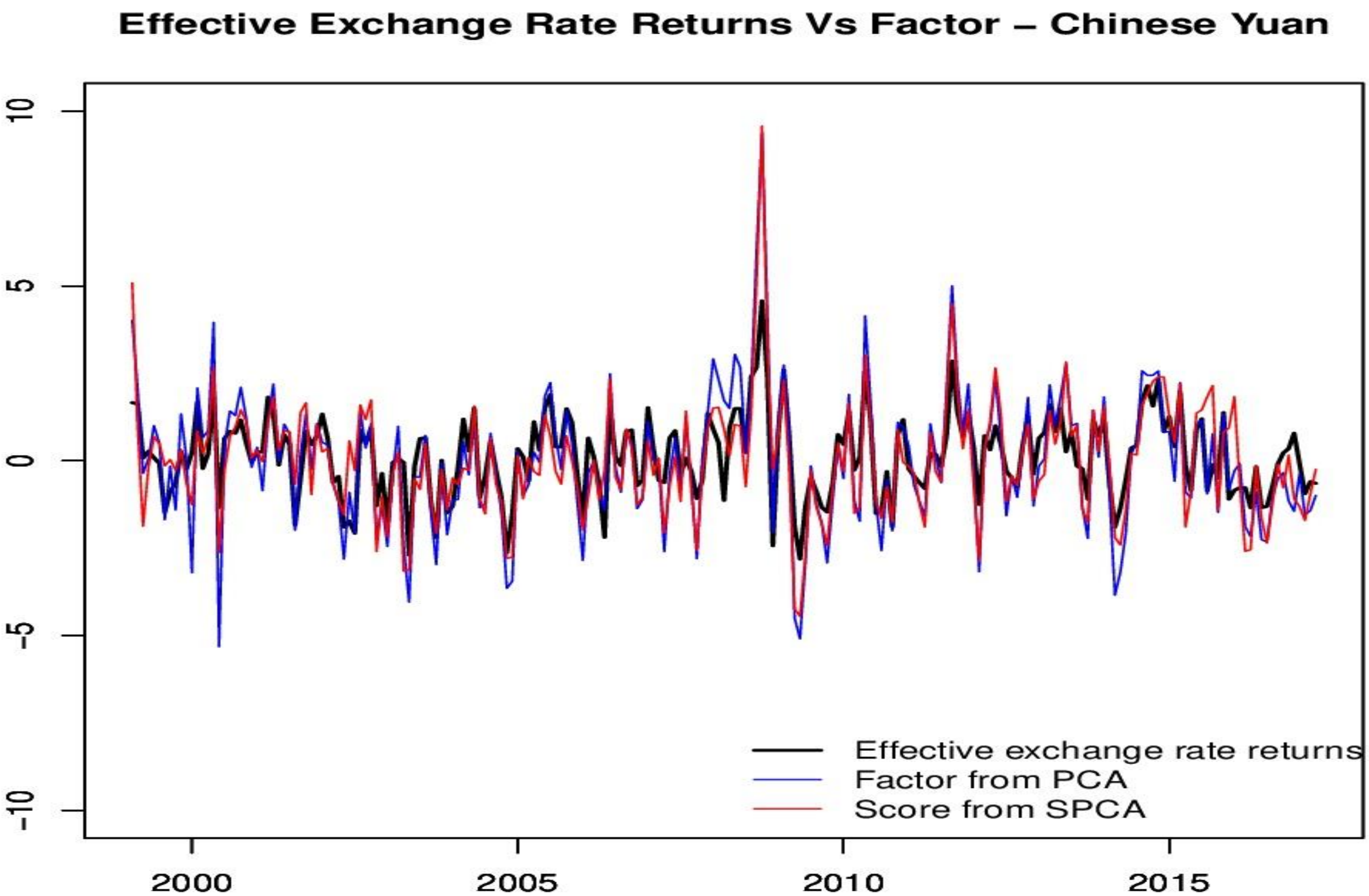

Figure 2b. Effective exchange rate Vs factor (in level) for the Chinese Yuan.

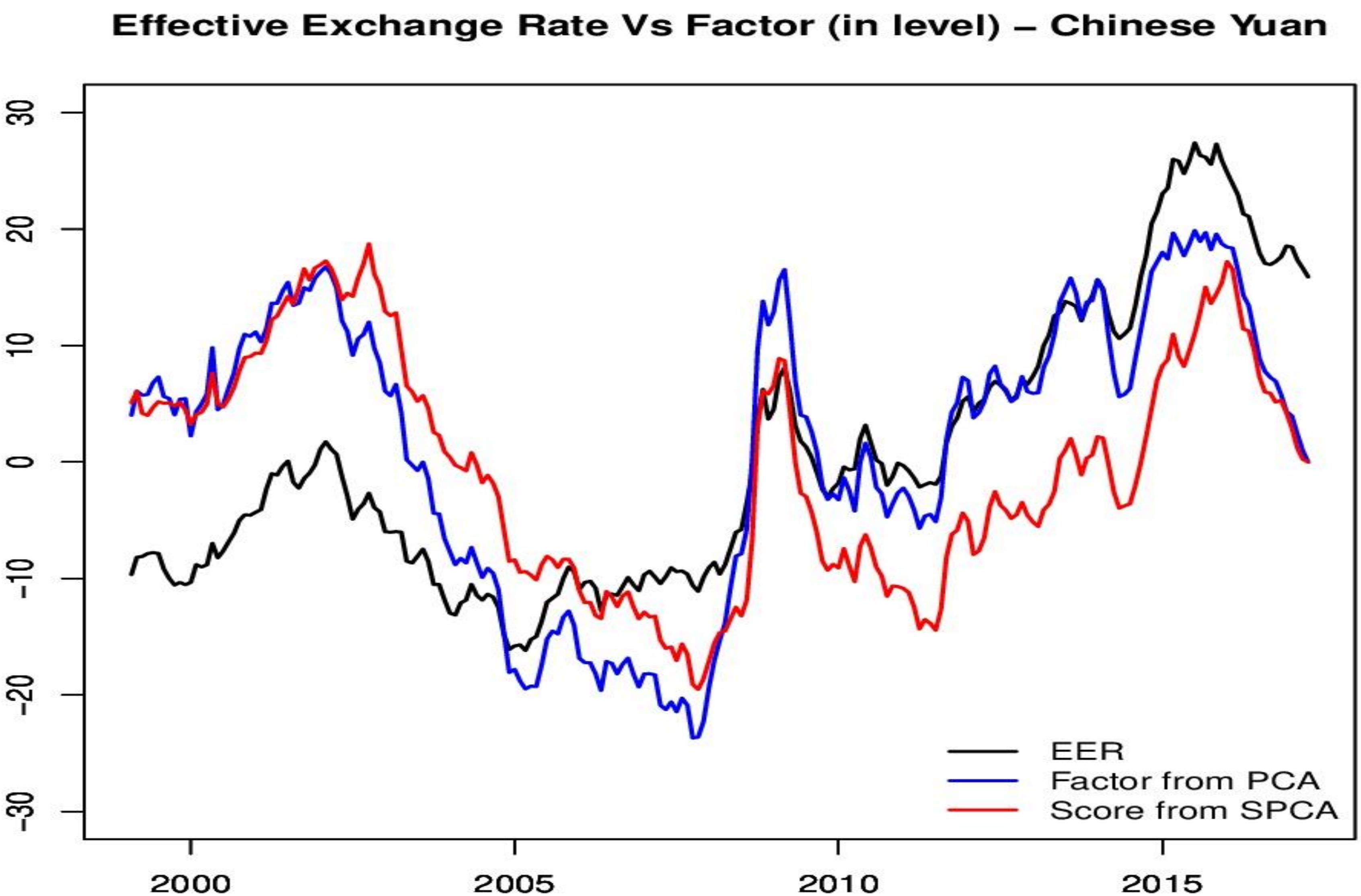

Table 2. Loadings estimates for the Chinese Yuan

	Loadings obtained by PCA	Loadings obtained by SPCA*
Euro	0.376	0.204
Japanese Yen	**0.128**	**0.000**
Hong Kong Dollar	**0.121**	**0.000**
South Korean Won	0.399	0.289
Macanese Pataca	**0.179**	**0.000**
Indian Rupee	0.365	0.156
Russian Ruble	0.267	0.355
Brazilian Real	0.286	0.660
Pound Sterling	0.328	0.140
South African Rand	0.356	0.507
Philippine Peso	0.320	0.110
US Dollar	**0.113**	**0.000**

Note: *The BIC minimization led to $\lambda^o = 0.04$.

Figure 3a. Effective Exchange Rate Returns Vs Factor for Russia and Brazil.

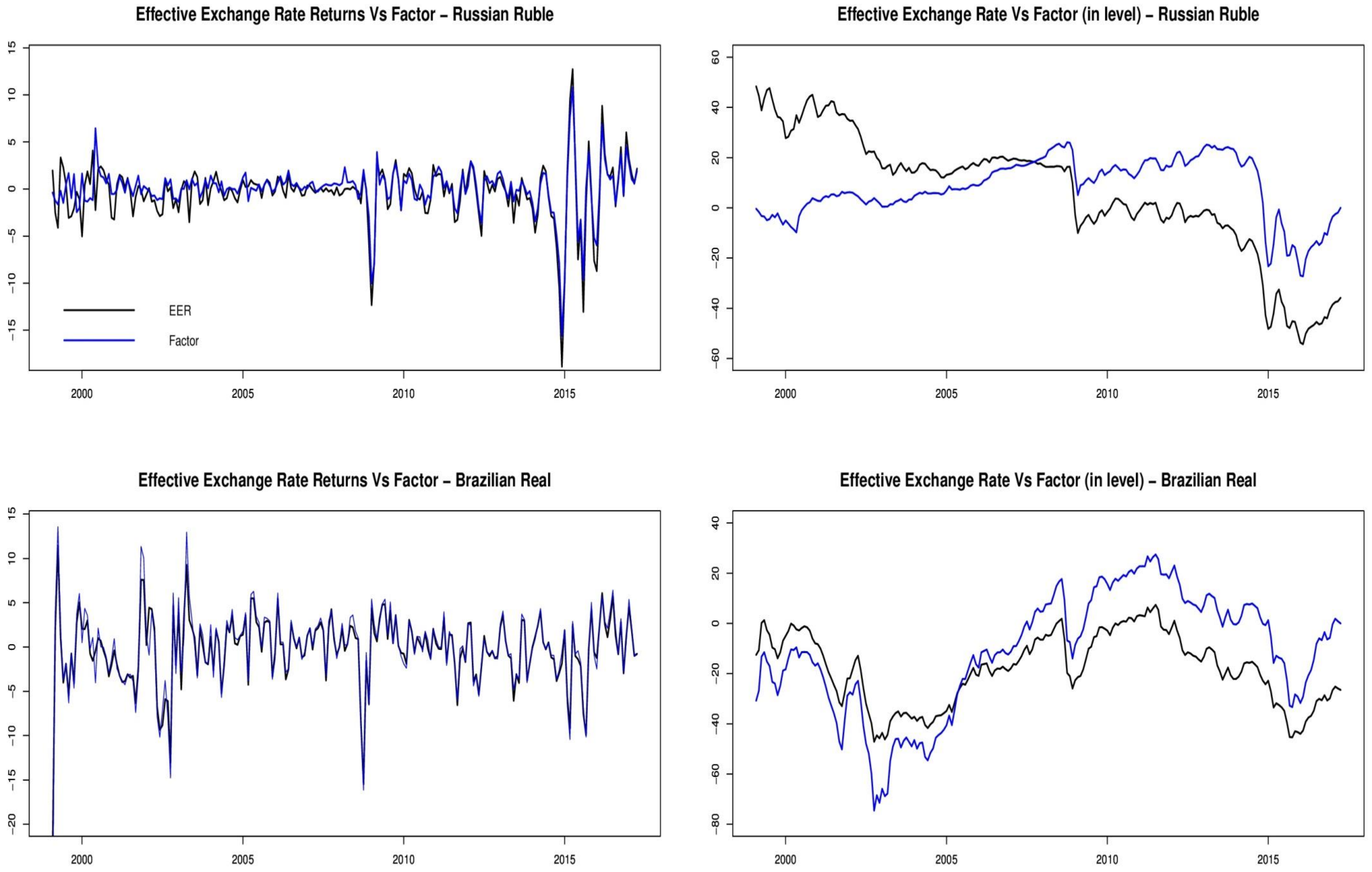

Figure 3b. Effective Exchange Rate Returns Vs Factor for India and South Africa.

Conclusion: if EER is missing, do PANIC without stressing

- we propose to combine PANIC procedure and sparse principal component analysis to estimate EER.

- Our results show that the procedure provides good approximations.

- Extensions that deserve to be explored:

  - inference should consider presence of structural breaks,
  - Switching regime dynamic,
  - or other kind of instability (time-varying parameters),
  - presence of outliers, ARCH effect (for high freq data),
  - …