RER Models in the Chilean Central Bank

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Banco de la República, Bogotá. August 18th 2010

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Introduction

- A key relative price in an open economy is the exchange rate
- The CCB does not have any target for this variable, however
  - It is an input for forecasting exercises
  - The main macro models of the bank need a ”long run value” of the exchange rate
- The relevant relative price is the real exchange rate (RER)
- This variable is computed by the CCB

Introduction

- Also the CCB may intervene the foreing exchange rate market if
  - The foreign exchange rate does not accurately reflect its fundamentals
  - This misalignmet has negative consequences for the macroeconomy
  - In this case, central bank's actions should help eliminate asymmetries
  - ....andor counteract the speculation encouraged by certain economic agents

Introduction

- We have three types of models
  - PPP. In this case, the RER is assumed to be mean reverting. Hence the RER equilibrium level is given by the RER mean over a period of time (1986-2006)
  - Fundamental Exchange Rate Equilibrium (FEER) Models. In this case, equilibrium RER is consistne with both internal and external equilibrium
  - Behaviuoral Equilibrium Exchange Rate (BEER) Models. The evolution of the RER is coherent with its fundamental determinants

FEERs Models

- Equilibrium RER is characterized by internal and external balance. Which means that
  - Current Account is in a sustainable level
  - The output gap is zero
  - Terms of trade are in their long-run level
- Simply stated, at any point in time the equilibrium RER should solve the following equation

$$CA_t = P_{x,t} X_t(RER_t, ygap_t^*) - P_{m,t} M_t(RER_t, ygap_t) + NFT_t \quad (1)$$

- And, in the long-run, the RER should solve

$$\overline{CA} = \overline{P_x} X(RER, ygap^*) - P_m M(RER, ygap) + NFT \quad (2)$$

FEERs Models

- For FEERs models need to know
  - Exports and Imports elasticities to RER
  - Exports and Imports elasticities to ygap domestic and foreign
  - CA and NFT in the long-run
  - Long-run terms of trade

FEERs Models: X and M elasticities

- We estimate X and M dynamic equations

$$dln\left(\frac{X}{Y}\right)_t = 0,09ln(RER_t) + 0,18ln\left(\frac{X}{Y}\right)_{t-1} + ... \quad (3)$$

$$dln\left(\frac{M}{Y}\right)_t = -0,15ln(RER_t) - 0,35ygap_t^* - 0,12ln\left(\frac{M}{Y}\right)_{t-1} + . \quad (4)$$

- So, in the long run (when dln(..)=0)

$$ln\left(\frac{X}{Y}\right) = 0,5ln(RER) \quad (5)$$

$$ln\left(\frac{M}{Y}\right) = -1,27ln(RER) - 2,94ygap^* \quad (6)$$

FEERs Models: Equilibrium RER

- In the long run, the RER should solve

$$\begin{aligned}\frac{CB}{Y} &= \frac{Px}{Py}\frac{X}{Y} - \frac{Pm}{Py}\frac{M}{Y} \\ &= \frac{Px}{Py}exp^{0,5(RER)} - \frac{Pm}{Py}exp^{-1,27(RER)}\end{aligned} \tag{7}$$

- Where $ygap^* = 0$ and we set $\frac{CB}{Y} = 0,1\%$

BEERs Models

- Equilibrium RER is coherent with its fundamental variables
- In particular, RER evolves according to
  - The evolution of relative productivity between tradable and non tradable sectors (*TNT*)
  - The Net Foreign Asset Position of the Economy (*NFA/Y*)
  - Terms of trade (*ToT*)
  - Government expenditure (*G/Y*)
  - Tariffs (*T*)
- In particular,

$$RER_t = \alpha_0 + \alpha_1 TNT_t + \alpha_1 \left(\frac{NFA}{Y}\right)_t + \alpha_2 ToT_t + \alpha_3 \left(\frac{G}{Y}\right)_t + \alpha_4 T_t \quad (8)$$

BEERs Models: Estimation Methodology

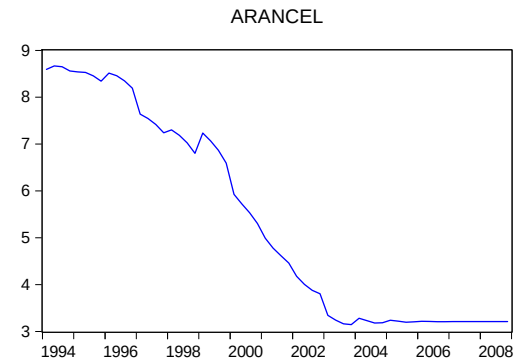
- Use Dynamic OLS (DOLS) to estimate long run relationship

$$ln(RER_t) = \beta X_t + \sum_{k=-p1}^{p2} \gamma_k \Delta X_{t-k} + \varepsilon_t$$

- Use OLS to estimate the error correction model (ECM)

$$\Delta ln(RER_t) = -\theta \left(ln(RER_{t-1}) - \beta X_{t-1} \right) + \sum_{j=0}^{\tau} \left(\delta_j \Delta X_{t-j} + .. \right) + \epsilon_t$$

Data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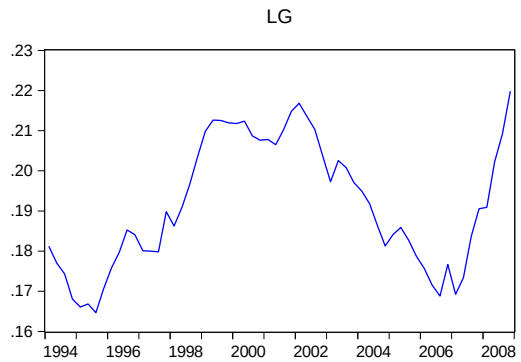
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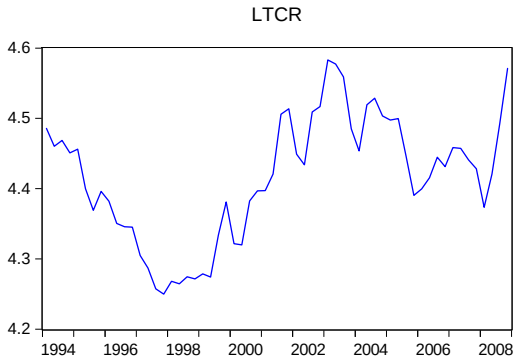
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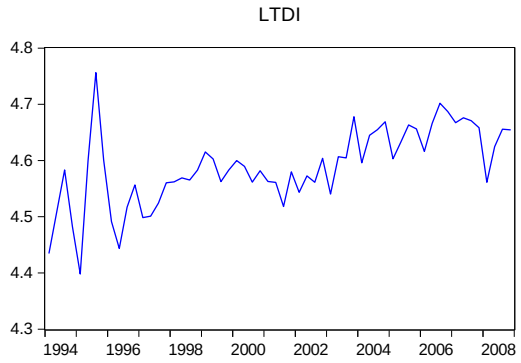
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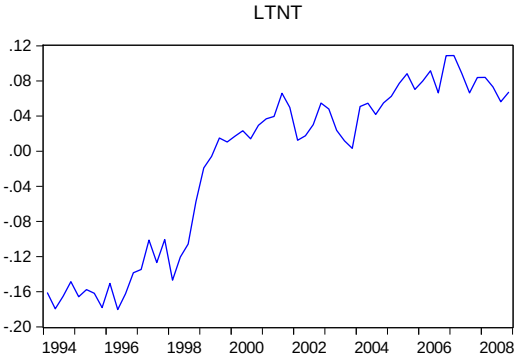
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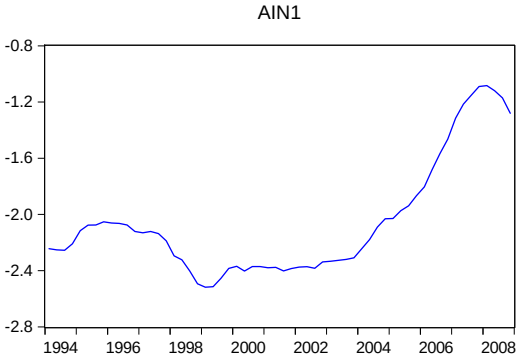
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-1.2
-1.6
-2.0
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-2.8
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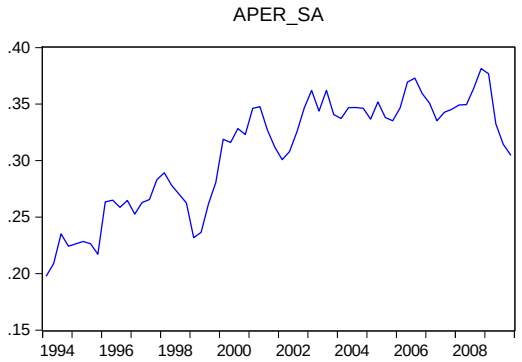
Long-Run Elasticities

Table 2: BEER Model Estimation Results (*Estimation w/ Alternative Terms of Trade*)

Coefficient	Eq.(4)	Eq.(4)
Constant	7.18***	7.22***
	(0.9)	(1.2)
$LTNT$	-0.27**	0.05
	(0.1)	(0.1)
$LToTXM$	-0.57***	-0.47**
	(0.2)	(0.2)
$(\frac{G}{Y})$	-2.15***	-3.52***
	(0.6)	(0.6)
$(\frac{NFA}{Y})$	-0.16***	-
	(0.0)	
$(\frac{NEP}{Y})$	-	-0.11***
		(0.0)
$TARIFF$	-0.02***	-0.02 ***
	(0.01)	(0.01)
Adj.R^2	0.815	0.754

sample: 1977.I-2007.IV
s.e. in parenthesis
*** significance at 99 %
** significance at 95 %
* significance at 90 %

Data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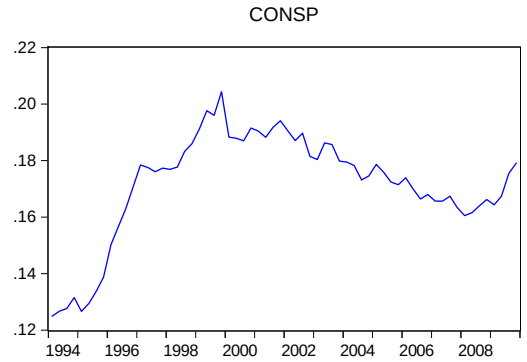
1994 1996 1998 2000 2002 2004 2006 2008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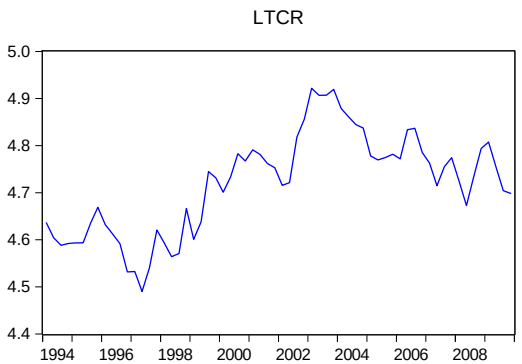
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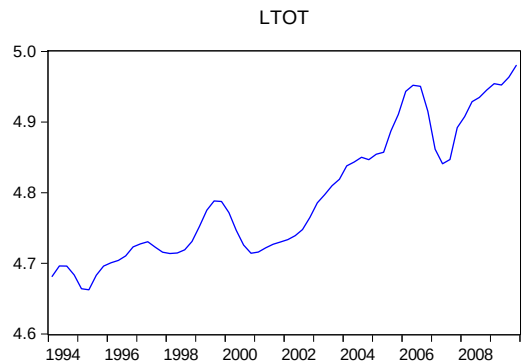
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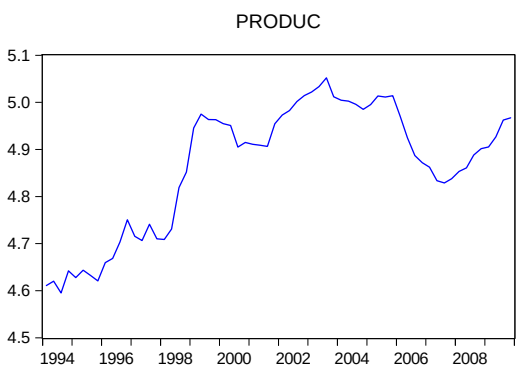
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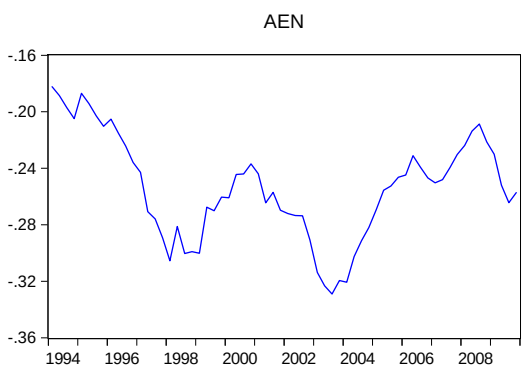
AEN
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1994 1996 1998 2000 2002 2004 2006 2008

Long-Run Elasticities

Coefficient	Colombia
C	3.25***
	(0.64)
TNT	-0.73***
	(0.12)
ToT	-0.43***
	(0.12)
G/Y	-3.62***
	(0.80)
AIN/Y	-0.52***
	(0.29)
ARAN	-1.45***
	(0.31)
Adjusted R2	0.826
Sample	1994.1-2009.III

*** significant at 99%

** significant at 95%

* significant at 90%

Long-Run Elasticities

Coefficient	Colombia	Chile
C	3.25***	7.18***
	(0.64)	(0.85)
TNT	-0.73***	-0.27**
	(0.12)	(0.12)
ToT	-0.43***	-0.57***
	(0.12)	(0.16)
G/Y	-3.62***	-2.15***
	(0.80)	(0.56)
AIN/Y	-0.52***	-0.16***
	(0.29)	(0.03)
ARAN	-1.45***	-0.024***
	(0.31)	(0.01)
Adjusted R2	0.826	0.815
Sample	1994.1-2009.III	1977.I-2007.IV

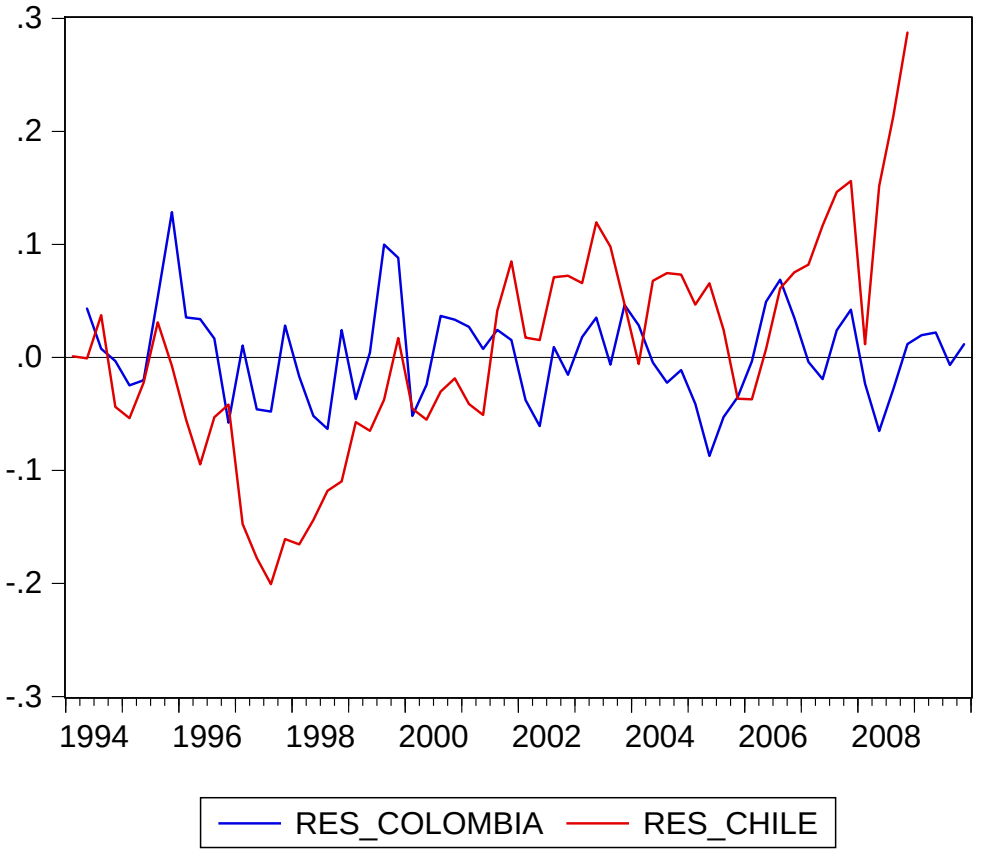
*** significant at 99%

** significant at 95%

* significant at 90%

RER misalignment: More persistent in Chile

$$Res_t = RER_t - \left(\alpha_0 + \alpha_1 TNT_t + \alpha_1 \left(\frac{NFA}{Y} \right)_t + \alpha_2 ToT_t + \alpha_3 \left(\frac{G}{Y} \right)_t + \alpha_4 T_t \right)$$



ECM: Faster adjustment in Colombia

- We estimate an ECM for both, Colombia and Chile

$$\Delta ln(RER_t) = -\theta \left(ln(RER_{t-1}) - \beta X_{t-1} \right) + \sum_{j=0}^{\tau} \left(\delta_j \Delta X_{t-j} + .. \right) + \epsilon_t$$

- In the case of Colombia, $\theta = 0,59$. In Chile, $\theta = 0,14$
- Hence, in Colombia misalignment dissipates, on average, after 1,7 quarters. In Chile, it takes 7 quarters.

Long-Run Equilibrium in BEERs Models

- Again, in the long-run need to know the equilibrium value of fundamentals

$$\overline{RER} = \alpha_0 + \alpha_1 \overline{TNT} + \alpha_1 \left(\frac{\overline{NFA}}{Y} \right) + \alpha_2 \overline{ToT} + \alpha_3 \left(\frac{\overline{G}}{Y} \right) + \alpha_4 \overline{T} \quad (9)$$

- Some long-run levels set according to historical trends (TNT, NFA/Y, G/Y). In the case of ToT set according to long-run price of copper and oil.

Equilibrium Concepts

- Models are used to assess the long-run level of the RER
- However, models can also be used to assess a counterfactual scenario
  - What would be the RER if fundamentals (in both FEER and BEER models) are to be in the long-run at the same level than today
  - This scenario can further inform as to whether a RER level is misaligned with respect to the short-run value of fundamentals