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BRIC: STEP BY STEP

Stable aggregate BRIC-currency constructing

Dmitry N. Kolesov

Head of Chair “Economical Cybernetics”, Ph.D. (Economics)

Sergey F. Sutyrin

Head of Chair “World Economy”, Dr. Sc. (Economics)

Nikolai V. Hovanov

Professor of Chair “Economical Cybernetics”, Dr. Sc. (Math.)

Faculty of Economics

St. Petersburg State University

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Simple and aggregated currencies. Monetary indices of exchange-value. Stable Aggregated Currency (SAC). Virtual units of account.

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1. EXTENDED SIMPLE EXCHANGE MODEL

Set of simple goods: $G=\{g_1,...,g_n\}$

Set of measurement-units: $E=\{e_1,...,e_n\}$

Quantity of simple good: $q_i \cdot e_i$, $q_i \geq 0$

Exchange-coefficient of simple goods: $c(i,j;t)$ – number of units e_j exchangeable to one unit e_i at the moment t

Exchange-matrix of simple goods:

$C(t)=(c(i,j;t))$, $c(i,j;t)>0$, $i,j=1,...,n$

Set of aggregate goods:

$AG=\{\bar{q}=(q_1,...,q_n): q_i \geq 0, q_1+...+q_n>0\}$

Set of basic aggregate goods:

$V=\{\bar{v}=(v_1,...,v_n): v_i \geq 0,\ v_1+...+v_n=1\}$

Representation of aggregate good: $\bar{q}=\lambda \cdot \bar{v}$, $\lambda>0$

"Natural" unit : $\bar{q}=q \cdot \bar{v}$, $v_i=q_i/q$, $q=q_1+...+q_n$

Exchange-coefficients of simple and aggregate goods:

$c(\bar{v},k;t)=v_1 c(1,k;t)+...+v_n c(n,k;t)$

2. IMF SPECIAL DRAWING RIGHTS (SDR) AS AN AGGREGATE GOOD (CURRENCY)

Weight-coefficients (fixed at January 1, 2006):

w1 = w(*EUR*) = 0.34 w2 = w(*GBP*) = 0.11

w3 = w (*JPY'*) = 0.11 w4 = w(*USD*) = 0.44

Quantities (fixed for the period 01.01.06–31.12.10):

q1 = q(*EUR*) ≈ 0.41 q2 = q(*GBP*) ≈ 0.09

q3 = q(*JPY'*) ≈ 0.18 q4 = q(*USD*) ≈ 0.63

$\overline{q} = (q_1,...,q_4)$ – aggregate currency *SDR*

Relative quantities vi = qi / [q1+q2+q3+q4]:

v1 = v(*EUR*) ≈ 0.31 v2 = q(*GBP*) ≈ 0.07

v3 = q(*JPY'*) ≈ 0.14 v4 = q(*USD*) ≈ 0.48

$\overline{v} = (v_1,...,v_4)$ – basic aggregate good SDR*

$$\overline{q} = (q_1,...,q_4) = \lambda \cdot (v_1,...,v_4) \quad , \quad \lambda \approx 1.316$$

3. MONETARY INDICES OF EXCHANGE-VALUE

Monetary Index (*MIND*) of "value in exchange":

$$c(i,j;t) = MIND(e_i;t) \Big/ MIND(e_j;t)$$

Primitive Monetary Index (*PMI*):

$$PMI(i;k;t) = c(i,k;t)$$

$$PMI(\bar{v};k;t) = c(\bar{v},k;t)$$

Multiplicative Monetary Index (*MMI*) (*Jevons Index*):

$$MMI(i;t) = [c(i,1;t) \cdot \ldots \cdot c(i,n;t)]^{1/n}$$

$$MMI(\bar{v};t) = [c(\bar{v}/1;t) \cdot \ldots \cdot c(\bar{v}/n;t)]^{1/n}$$

Reduced Monetary Index (*RMI*):

$$RMI(i;t/t_0) = MMI(i;t) \Big/ MMI(i;t_0)$$

$$RMI(\bar{v};t/t_0) = MMI(\bar{v};t) \Big/ MMI(\bar{v};t_0)$$

RMI* – variation-index of exchange-value index *MMI

4. AGGREGATE GOOD OF MINIMAL VOLATILITY

Measure of aggregate good's exchange-value volatility - variance of time series $RMI(\bar{v};t/t_0) \quad t=1,...,T$

$S^2(\bar{w}) \quad \bar{w}=(w_1,...,w_n)$

$w_i=[v_i c(i,k;t_0)]/[v_1 c(1,k;t_0)+...+v_n c(n,k;t_0)]$

$$S^2(\bar{w})=\sum_{i,j=1}^{n} w_i \cdot w_j \cdot \mathrm{cov}(i,j)$$

$\mathrm{cov}(i,j)=\mathrm{cov}(RMI(i),RMI(j)) \quad \mathrm{cov}(i,i)=SRMI^2(i)$

Optimization problem: minimize variance

under constraints $w_i \geq 0 \quad w_1+...+w_n=1$

$\min S^2(\bar{w})=S^2(\bar{w}^*) \quad \bar{w}^*=(w_1^*,...,w_n^*)$

Stable Aggregate Good (Currency) – *SAG* (*SAC*):

$$\bar{v}^*=(v_1^*,...,v_n^*)$$

$v_i^*=[w_i^*/c(i,k;t_0)]/[w_1^*/c(1,k;t_0)+...+w_n^*/c(n,k;t_0)]$

5. STABLE AGGREGATE BRIC-CURRENCY

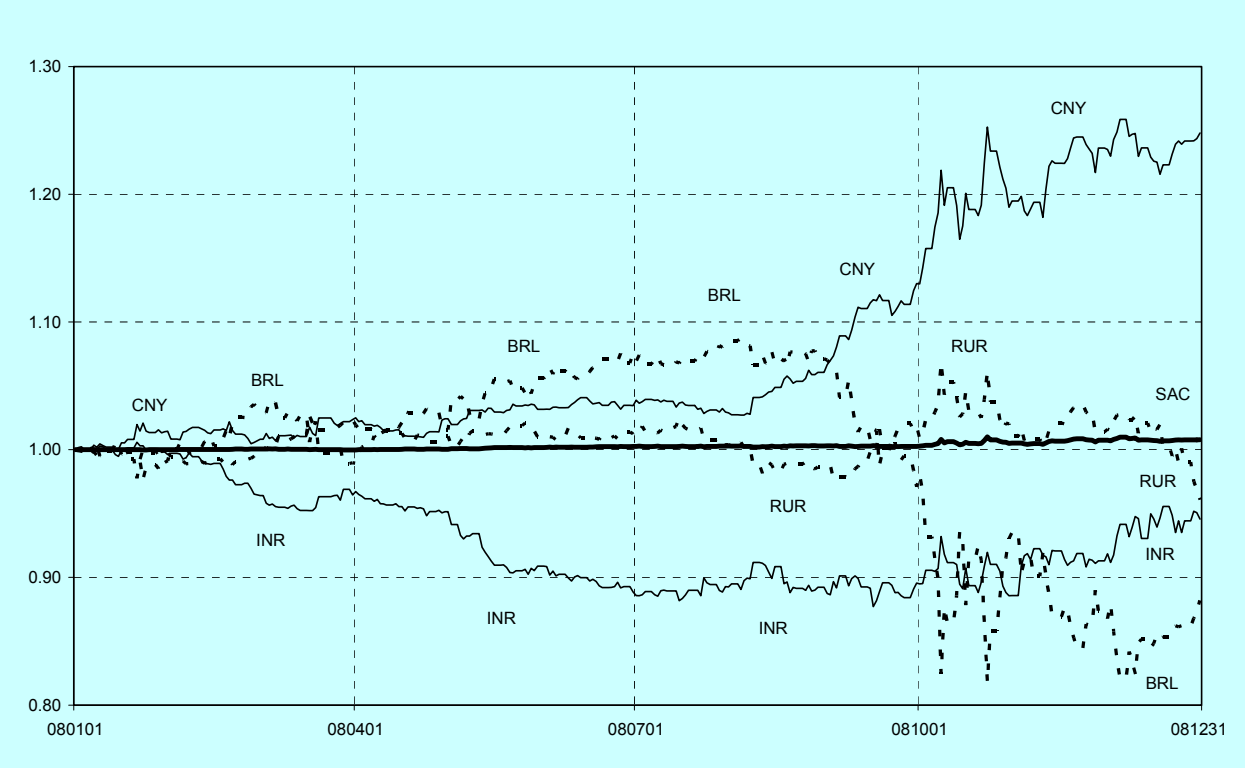
Learning period: 01.01.2007–31.12.2007

SAC = *SAC*(BRIC) =

= {0.573**BRL*; 0.228**CNY*'; 0.125**INR*'; 0.074**RUR*'}

JPY'=100**JPY*; *CNY*'=10**CNY*;
INR'=100**INR*; *RUR*'=100**RUR*

Testing period: 01.01.2008–31.12.2008



Dynamics of variation-indices *RMI*(*XYZ*;t/1)
of exchange-value indicators *MMI*(*XYZ*;t/1),
XYZ=*BRL*,*CNY*,*INR*,*RUR*,*SAC*=*SAC*(BRIC)

6. STATISTICS OF VARIATION–INDICES *RMI* OF EXCHANGE-VALUE INDICATORS *MMI*

Statistics of variation–indices *RMI*(*XYZ*;t/1)
XYZ=*BRL*,*CNY*,*INR*,*RUR*,*EUR*,*GBP*,*JPY*,*USD*,
SAC=*SAC*(BRIC), *SAC**=*SAC*(EGJU)

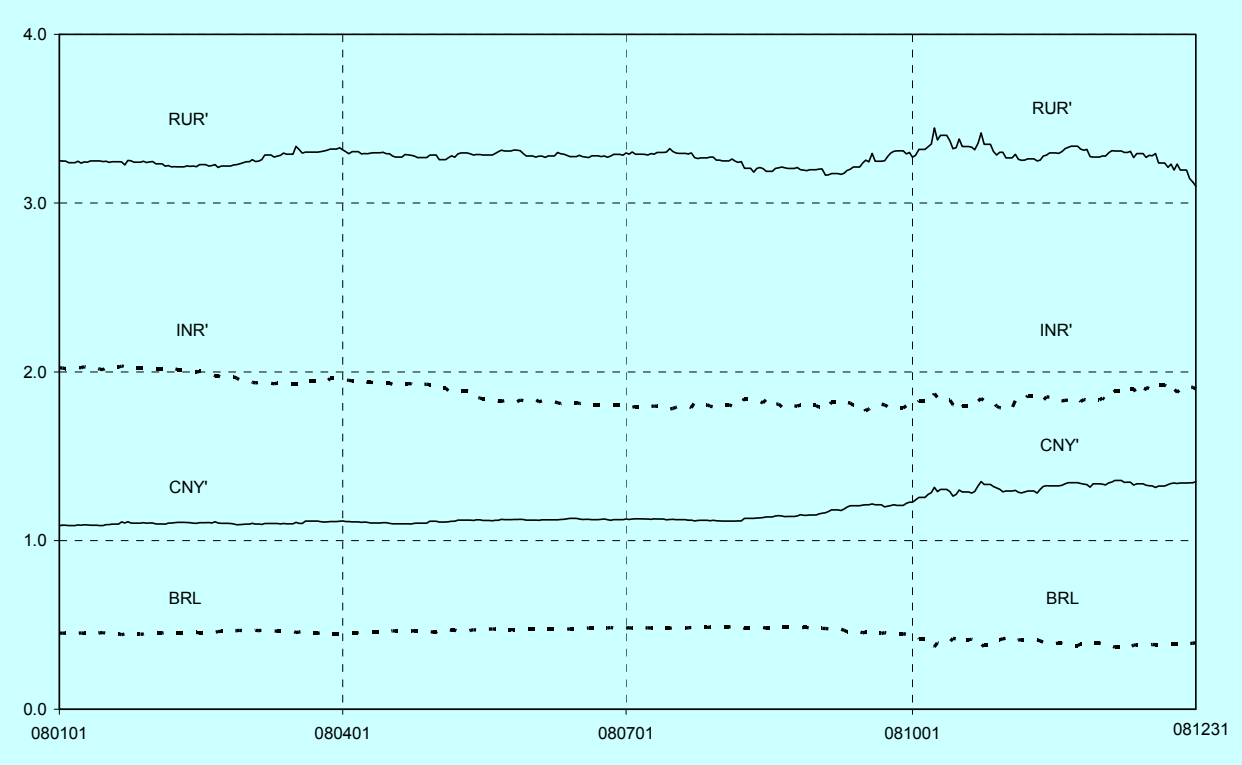
Statistics	*BRL*	*CNY*	*INR*	*RUR*	*SAC*
Mean	0.995	1.080	0.929	1.008	1.003
Min	0.818	1.000	0.877	0.961	1.000
Max	1.087	1.259	1.006	1.068	1.010
Range	0.269	0.259	0.129	0.107	0.010
St. Dev.	0.075	0.084	0.037	0.015	0.003

*SAC** = *SAC*(EGJU) =

= {0.213**EUR*; 0.148**GBP*; 0.344**JPY*'; *0.295**USD}

Statistics	*EUR*	*GBP*	*JPY'*	*USD*	*SAC**
Mean	0.999	0.922	1.091	1.002	1.004
Min	0.899	0.750	1.000	0.947	1.000
Max	1.047	1.000	1.300	1.081	1.020
Range	0.148	0.251	0.300	0.133	0.020
St. Dev.	0.039	0.064	0.089	0.035	0.006

7. STABLE AGGREGATE BRIC-CURRENCY AS A VIRTUAL UNIT OF ACCOUNT



Dynamics of exchange-coefficients c(*XYZ*,*SAC*;t), *XYZ=BRL*,*CNY'*,*INR'*,*RUR'*, *SAC=SAC*(BRIC)

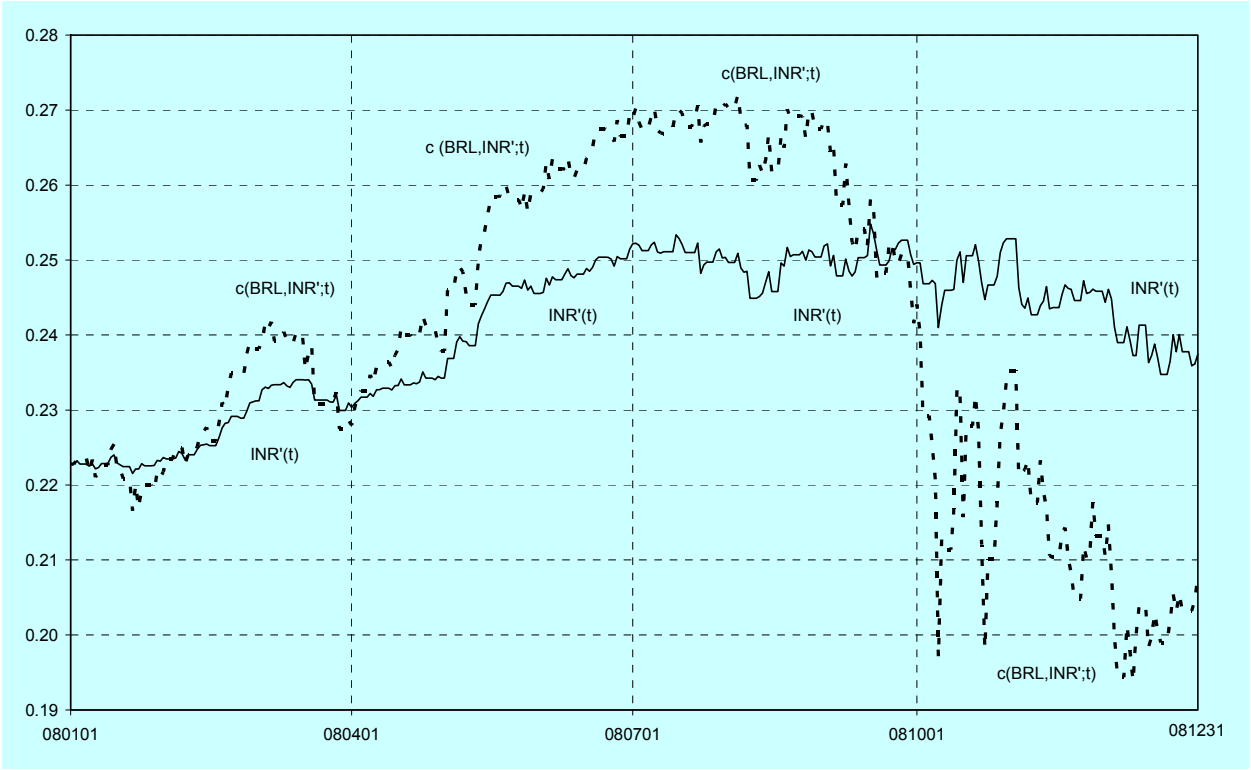
Statistics	***BRL***	***CNY'***	***INR'***	***RUR'***
Mean	0.448	1.172	1.875	3.270
Min	0.365	1.088	1.769	3.100
Max	0.489	1.356	2.035	3.445
Range	0.123	0.269	0.266	0.346
St. Dev.	0.034	0.089	0.078	0.045
C. Var.	0.077	0.076	0.041	0.013

8. STABLE AGGREGATE BRIC-CURRENCY AS A STORAGE OF EXCHANGE-VALUE

At the moment *t*(0)=01.01.2008 an investor exchanges 1**BRL* for SAC = *SAC*(BRIC):
1*BRL → c(BRL,SAC;t(0)) = 0.4508*SAC

At the moment *t* from the period [01.01.2008, 31.12.2008] the investor may exchange his 0.4508**SAC*(BRIC) for *BRL*(t)=c(*BRL*,*SAC*;t(0))*c(*SAC*,*BRL*;t)**BRL*

9. STABLE AGGREGATE BRIC-CURRENCY AS A CURRENCY OF CONTRACTS



At the moment t(0)=01.01.2008 a Brazilian buyer ("B") and an Indian Producer ("P") may negotiate contracts:

C1: "B" must pay 1*BRL for the production of "P" at the fixed moment *t* from [01.01.2008-31.12.2008] So, at the moment *t* "P" will obtain 1*BRL which may be exchanged for 100*c(BRL,INR';t) Indian Rupees

C2: "B" must pay c(BRL,SAC;t(0))*c(SAC,BRL;t) BRL for the production of "P" at the fixed moment *t* . So, "P" will obtain c(BRL,SAC;t(0))*c(SAC,BRL;t)**BRL* which may be exchanged for *INR'*(t) Indian Rupees: *INR'*(t)=100*c(BRL,SAC;t(0))*c(SAC,INR';t)**INR'*

10. WORLD AND REGIONAL STABLE AGGREGATE CURRENCIES

1. Hovanov N.V., Kolari J.W., Sokolov M.V. Aggregated world currency of minimal risk // “MASR-2002”. SPb., 2002.
2. Хованов Н.В., Колесов Д.Н., Соколов М.В. Простая модель обмена: агрегированные валюты минимальной волатильности // Применение математики в экономике. №13. 2004.
3. Колесников Г.И., Сутырин С.Ф., Хованов Н.В. К созданию коллективной валюты стран ЕврАзЭС // Евразийская интеграция. Экономика, право, политика. 2007. № 2.
4. Viale A., Kolari J., Hovanov N., Sokolov M. Computing and testing a stable common currency for MerCoSur countries // Journal of Applied Economics. 2008. Volume XI.
5.Pontines V., Rajan R.S. The Asian Currency Unit (ACU): exploring alternative currency weights // Macroeconomics and Finance in Emerging Market Economies. 2008. Volume 1.

“A commodity which is itself continually varying in its own value, can never be an accurate measure of the value of other commodities”

Smith A. “An Inquiry into the Nature and Causes of the Wealth of Nations”. 1776

Thanks for your attention!

Additional information

about the theory and applications

of stable aggregate currencies

you can find on web-site:

finance.polydecision.com

E-mail for contacts:

nick@polyidea.com