

Emerging EUs and their exchange rates ex ante and ex post Sub-prime Crisis

Kentaro Kawasaki
Toyo University, Tokyo Japan

Summary

- Motivations
- What's happened on Central European currencies after sub-prime?
- Vulnerabilities in Central&Eastern European countries
- Prescriptions

Empirical Analysis: Hungary, Just the First to fall?

- Crisis spills over from the U.S. to Europe
- Stock prices in Central and Eastern Europe fell 30% a month in October 2008
- The Hungarian forint & The Polish zloty fell 13.6% by the 4th week of Oct.
- What's going on the exchange rates on the Central European currencies?

Unit root tests for ERM II countries

- ERM II countries: keep nominal exchange rates in the band ($\pm 2.25\%$, or $\pm 15\%$)
- Assumption: M.A. keep deviations from their central parity stable, then EXRs are
 - Stationary process: M.A. could control their exchange rates perfectly!
 - Non-stationary, but in the band: M.A. could be fully trusted!

Unit root tests for non ERM II countries

- Non-ERM II countries do not have no central parity, but have 'implicit exchange rate target'
- Assumption: M.A. keep deviations from their implicit EXR targeting changes stable, then changes in EXR are
 - Stationary process: M.A. could control their exchange rates perfectly!
 - Non-stationary: M.A. could not control their exchange rates at all!

Are adjustment process linear or non-linear?

- Usual unit root models such like the DF/ADF test assume linear reverting process.
- Mean reverting process in depreciation/appreciation might be at same speeds.
- There are no much differences in determinants for depreciation/appreciation
- If there exist different factors between depreciation and appreciation, adjustment process should be assumed as non-linear.

Non-linear model of unit root test for ERM II countries

$$\Delta h_t = I_t \rho_1 h_{t-1} + (1 - I_t) \rho_2 h_{t-1} + \sum_{i=1}^p \alpha_i \Delta h_{t-1} + \varepsilon_t$$

$$I_t = \begin{cases} 1 & \text{if } h_{t-1} \geq 0 \\ 0 & \text{if } h_{t-1} < 0 \end{cases}$$

$H_0 : \rho_1 = \rho_2 = 0, H_1$; no unit root

$H_0 : \rho_1 = \rho_2, H_1$; asymmetric adjustment

Non-linear model of unit root test for non-ERM II

$$\Delta g_t = I_t \rho_1 \cdot g_{t-1} + (1 - I_t) \rho_2 \cdot g_{t-1} + \sum_{i=1}^p \alpha_i \Delta g_{t-1} + \varepsilon_t$$

$$I_t = \begin{cases} 1 & \text{if } \Delta g_{t-1} \geq 0 \\ 0 & \text{if } \Delta g_{t-1} < 0 \end{cases}$$

$H_0 : \rho_1 = \rho_2 = 0, H_1$; no unit root

$H_0 : \rho_1 = \rho_2, H_1$; asymmetric adjustment

Emerging EUs and their exchange rates: data

- Data: from *Datastream*
- Selected Central European Currencies (non-ERM II countries): The Hungarian forint, the Czech Koruna, and the Poland zloty
- ERM II: Denmark (for a reference case)
- Their nominal exchange rates against the Euro:

Emerging EUs and their exchange rates: Samples periods

- Whole sample period: 1.1.2004-1.12.2009
 - Period I: 1.1.2004 - 7.15.2008
 - Period II: 1.1.2007- 7.15.2008
 - Period III: 1.1.2008 - 7.15.2008
 - Period IV: 7.21.2008 - 1.12.2009

Table 2a: The TAR, and M-TAR unit root test for the Czech koruna

Sample Period	Model	DF	Lag(s)	Coefficient (with S.E.)	F statistics (Probability)		
					H: $\text{Rho}(+)=\text{Rho}(-)=0$	H: $\text{Rho}(+)=\text{Rho}(-)$	
May 1 2004 -Jan 12 2009	M-TAR	1218	0	Rho(+)	-0.949624441 ****	564.4459	0.194763
					0.039743481	0	0.65906024
				Rho(-)	-0.974910661 ****		
					0.041272142		
May 1 2004 - Jul 15 2008	M-TAR	1089	0	Rho(+)	-0.966246825 ****	531.2036	0.428262
					0.043550112	0	0.51298132
				Rho(-)	-1.005898827 ****		
					0.042127154		
Jan 1 2007 - Jul 15 2008	M-TAR	400	0	Rho(+)	-0.885322885 ****	177.68703	0.994678
					0.072986383	0	0.31920454
				Rho(-)	-0.984987147 ****		
					0.068257561		
Jan 1 2008 - Jul 15 2008	M-TAR	139	0	Rho(+)	-0.890248429 ****	66.17671	0.944532
					0.117324657	0	0.33280327
				Rho(-)	-1.054727087 ****		
					0.121970777		
Jul 21 2008 -Jan 12 2009	M-TAR	124	0	Rho(+)	-1.023754436 ****	57.90275	0.506915
					0.125937234	0	0.47781469
				Rho(-)	-0.896354647 ****		
					0.127115667		

Note: $a(0)$ and $a(1)$ denote the coefficients a_0 and a_1 in Equation (2.3), $\text{Rho}(+)$ and $\text{Rho}(-)$ denote ρ_1 and ρ_2 in Equations (2.4) and (2.5) respectively.

Table 2b: The TAR, and M-TAR unit root test for the Hungarian forint

Sample Period	Model	DF	Lag(s)	Coefficient (with S.E.)	F statistics (Probability)		
					H: $\rho(+)=\rho(-)=0$	H: $\rho(+)=\rho(-)$	
May 1 2004 -Jan 12 2009	M-TAR	1214	3	Rho(+)	-1.056045343 ****	122.84998	9.521731
				Rho(-)	0.067848461 -0.878115518 **** 0.074103593	0	0.00207647
May 1 2004 - Jul 15 2008	M-TAR	1088	1	Rho(+)	-1.038477389 ****	300.84483	0.897807
				Rho(-)	0.048658506 -0.980989052 **** 0.054239948	0	0.34358088
Jan 1 2007 - Jul 15 2008	M-TAR	400	0	Rho(+)	-1.026983535 ****	191.3419	1.026827
				Rho(-)	0.068327273 -0.925012023 **** 0.073877643	0	0.31151756
Jan 1 2008 - Jul 15 2008	M-TAR	139	0	Rho(+)	-0.999814889 ****	60.79286	0.720592
				Rho(-)	0.113257184 -0.853938683 **** 0.129243531	0	0.39740927
Jul 21 2008 -Jan 12 2009	M-TAR	124	0	Rho(+)	-1.171368246 ****	66.20208	5.847794
				Rho(-)	0.11559757 -0.740173547 **** 0.135764146	0	0.01705033

Note: $a(0)$ and $a(1)$ denote the coefficients a_0 and a_1 in Equation (2.3), $\rho(+)$ and $\rho(-)$ denote ρ_1 and ρ_2 in Equations (2.4) and (2.5) respectively.

Table 2c: The TAR, and M-TAR unit root test for the Poland zloty

Sample Period	Model	DF	Lag(s)	Coefficient (with S.E.)	F statistics (Probability)		
					H: $\text{Rho}(+)=\text{Rho}(-)=0$	H: $\text{Rho}(+)=\text{Rho}(-)$	
May 1 2004 -Jan 12 2009	M-TAR	1218	1	Rho(+)	-0.962837079 **** 0.039481451	534.09011	0.957819 0.32793127
				Rho(-)	-0.906658357 **** 0.041668343		
May 1 2004 - Jul 15 2008	M-TAR	1088	1	Rho(+)	-0.954141418 **** 0.051171584	240.42584 0	0.87323 0.35026992
				Rho(-)	-0.897582799 **** 0.05291851		
Jan 1 2007 - Jul 15 2008	M-TAR	399	1	Rho(+)	-0.847746572 **** 0.084678774	73.40534 0	0.027989 0.86722058
				Rho(-)	-0.831153887 **** 0.085760224		
Jan 1 2008 - Jul 15 2008	M-TAR	138	1	Rho(+)	-0.84091857 **** 0.140512226	24.39782 0	0.025322 0.8737995
				Rho(-)	-0.814129195 **** 0.150890801		
Jul 21 2008 -Jan 12 2009	M-TAR	124	0	Rho(+)	-0.997749666 **** 0.127643429	52.69937 0	0.808382 0.37034179
				Rho(-)	-0.836674037 **** 0.125708344		

Note: $a(0)$ and $a(1)$ denote the coefficients a_0 and a_1 in Equation (2.3), $\text{Rho}(+)$ and $\text{Rho}(-)$ denote ρ_1 and ρ_2 in Equations (2.4) and (2.5) respectively.

Table 2d: The TAR and M-TAR unit root test for the Danish krona

Sample Period	Model	DF	Lag(s)	Coefficient (with S.E.)	F statistics (Probability)		
					H: $\text{Rho}(+) = \text{Rho}(-) = 0$	H: $\text{Rho}(+) = \text{Rho}(-)$	
May 1 2004 - Jan 12 2009	TAR	1223	1	Rho(+)	-0.000097996 ***	4.40773	8.749732
					0.000038222	0.012377	0.00315599
			Rho(-)	0.000027164			
				0.000018105			
M-TAR	1224	0	Rho(+)	0.000054385 ***	5.30628	10.53742	
				0.000022448	0.00507509	0.0012015	
			Rho(-)	-0.000052023 **			
				0.000023888			
May 1 2004 - Jul 15 2008	TAR	1094	1	Rho(+)	-0.000080677 **	3.69023	7.175953
					0.000036417	0.02527756	0.00749952
			Rho(-)	0.000027697			
				0.000017599			
M-TAR	1095	0	Rho(+)	0.00006072 ****	6.56639	12.874624	
				0.000021611	0.00146291	0.00034779	
			Rho(-)	-0.00005346 ***			
				0.000023358			

Note: $a(0)$ and $a(1)$ denote the coefficients a_0 and a_1 in Equation (2.3), $\text{Rho}(+)$ and $\text{Rho}(-)$ denote ρ_1 and ρ_2 in Equations (2.4) and (2.5) respectively.

Table 2d: The TAR and M-TAR unit root test for the Danish krona (cont.)

Sample Period	Model	DF	Lag(s)	Coefficient (with S.E.)	F statistics (Probability)		
					H: Rho(+)=Rho(-)=0	H: Rho(+)=Rho(-)	
Jan 1 2007 - Jul 15 2008	TAR	399	1	Rho(+)	-0.000094229	0.92895	1.812549
					0.000078346	0.39581998	0.17896707
				Rho(-)	0.000017391		
					0.000027102		
	M-TAR	400	0	Rho(+)	0.000061445 *	2.78084	5.506904
					0.000034837	0.06318546	0.01942865
Jan 1 2008 - Jul 15 2008	TAR	138	1	Rho(+)	-0.000113971	0.78208	1.537745
					0.000111784	0.45947145	0.21705815
				Rho(-)	0.000042954		
					0.000059263		
	M-TAR	139	0	Rho(+)	0.000070704	0.82208	1.607618
					0.000071029	0.44164135	0.20694669
Jul 21 2008 -Jan 12 2009	TAR	124	0	Rho(+)	-0.000335141	1.24999	2.3514
					0.000213767	0.29009259	0.12771806
				Rho(-)	0.000017318		
					0.000084467		
	M-TAR	124	0	Rho(+)	-0.000016989	0.08529	0.024743
					0.000115872	0.91829729	0.87526406
			Rho(-)	-0.000041984			
				0.000108734			

Note: a(0) and a(1) denote the coefficients a_0 and a_1 in Equation (2.3), Rho(+) and Rho(-) denote ρ_1 and ρ_2 in Equations (2.4) and (2.5) respectively.

Empirical results

- The Czech koruna & the Polish zloty:
 - M.A. could control exchange rates
- The Hungarian forint:
 - Mean reversion speeds in depreciating/appreciating are different.
 - Are there market negative sentiment?

Empirical results

- The Danish Krona:
 - Nominal exchange rates are fluctuating. There exist a unit root in a process (recent years).
 - But, the Danish Krona are still fluctuating in the band after sub-prime.
 - It comes from reputations of Euro or ERM II? or M.A. might be fully trusted!

Vulnerabilities in Central&Eastern European countries

- Property of deficit in current account in CEE countries
 - large current account deficits
 - Capital in-flow: short-term

Table 4: Transaction for current account deficit and its finance structures

(billion dollars)

	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
Current Account	-31.4	-15.5	-23.1	-36.8	-57.6	-59.4	-87.7	-120.7	-164.4	-174.2
Private capital net inflow	38.6	11.1	53.7	53.6	74.3	119.2	119.9	173.8	179.9	181.7
Direct investment	23.5	24.0	24.5	17.1	36.1	51.7	64.3	74.8	77.3	81.8
Securities investment	3.8	0.9	2.1	8.0	28.4	21.5	9.9	-7.7	10.4	15.5
Other investment	11.4	-13.8	27.2	28.5	9.8	45.9	45.6	106.7	92.2	84.5
Public capital net inflow	1.6	6.0	-7.5	-5.1	-6.0	-7.9	-4.7	-2.4	-2.4	-2.2
Foreign reserves change	-6.2	-2.7	-18.1	-12.8	-14.7	-45.9	-22.8	-41.6	-22.9	-21.3

Note: IMF prospect after 2008. Current account deficit showed minus. Capital net inflow showed plus.

Capital net outflow showed minus. Other investments include both long and short terms. Foreign reserves change of minus means the increasing. In definition, current account + private capital net inflow + public capital net inflow + foreign reserves change = 0, but for errors and omissions, it is not always zero.

Table 7: The amount of the foreign borrowing and the share of countries
(billion dollars, %)

	Central Europe			Barthes 3			South-Eastern Europe	
	Hungary	Poland	Czech	Estonia	Latvia	Lithuania	Romania	Bulgaria
Germany	23.0	17.2	6.2	1.9	10.4	11.1	3.9	9.8
France	7.3	7.4	17.7	0.4	0.8	1.1	13.5	7.3
Italy	18.2	18.6	10.4	1.0	3.1	1.6	9.6	20.4
Netherlands	3.4	13.4	3.0	0.0	0.1	0.3	7.7	1.2
Belgium	12.5	8.6	27.1	0.3	0.1	0.4	1.0	5.2
Austria	24.7	5.3	30.2	0.7	1.8	0.8	38.6	14.5
Sweden	0.2	2.4	0.1	83.2	58.4	59.8	0.1	0.0
Greece	0.1	0.0	0.0	0.0	0.1	0.0	16.2	27.5
U.K.	1.9	1.1	1.2	0.0	0.6	0.1	0.2	0.5
Others	4.9	19.1	1.7	12.3	23.7	24.8	7.9	12.1
Total (EU)	96.3	93.2	97.6	99.8	99.1	99.9	98.7	98.7
U.S.	1.9	4.6	1.8	0.1	0.1	0.1	1.2	1.0
The amount of borrowing	153.9	295.0	209.3	39.1	42.8	40.4	124.2	39.2
of GDP (%)	111.2	70.1	120.0	183.8	156.8	105.3	74.7	99.0

Note: Countries of lending in gray are suffered big damage. Items of share in gray are over 15%.

The data of the amount of borrowing is in June, 2008. The data for GDP is 2007.

Source: BIS, Banking Statistics.

Table 5: Conditions of financing for the current account deficit in each country

		Hungary	Poland	Czech	Latvia	Lithuania	Estonia	Romania	Bulgaria
06	① Current Account (of nominal GDP)	-7.6	-2.7	-2.6	-22.5	-10.6	-16.7	-10.4	-17.8
	② Foreign Direct Investment (do.)	1.1	3.2	2.8	7.5	5.1	4.2	8.9	23.3
	① + ② (Pt)	-6.5	0.4	0.2	-15.0	-5.6	-12.6	-1.5	5.4
07	① Current Account (of nominal GDP)	-6.2	-4.7	-1.8	-23.8	-14.6	-18.1	-14.1	-21.8
	② Foreign Direct Investment (do.)	3.2	4.2	4.5	7.1	3.6	5.3	6.0	21.8
	① + ② (Pt)	-3.0	-0.5	2.7	-16.7	-11.0	-12.8	-8.1	0.0
08 Q2	① Current Account (of nominal GDP)	-6.1	-4.9	-2.5	-19.7	-15.5	-14.1	-13.9	-24.2
	② Foreign Direct Investment (do.)	3.0	3.3	4.7	5.2	2.8	5.4	6.7	18.5
	① + ② (Pt)	-3.1	-1.6	2.2	-14.5	-12.7	-8.7	-7.1	-5.6

Note: The current account deficit of 08-Q2 is the average of last 4 terms. If ①+② is plus, the deficit is financed by the foreign direct investment. The items in gray mean the cases not to be financed.

Source: Eurostat, each Central Banks

Vulnerabilities in Central&Eastern European countries

- The short-term ability to pay :
 - The ratio of the amount of import in foreign reserves (more than 3 months) or
 - the ratio of the foreign short-term debt in those (more than 1.0) large current account deficits

Table 6: The ability to pay for the foreign debt in each country.

	Hungary	Poland	Czech	Latvia	Lithuania	Estonia	Romania	Bulgaria
Foreign Reserves (U.S. billion)	27.2	79.4	37.7	6.3	7.2	4.0	39.4	19.7
The ratio of the short-term debt in foreign Reserves (times)	1.07	1.17	1.12	0.39	0.81	0.43	1.42	1.02
Changes from last year (Pt)	-0.39	-0.41	-0.63	0.03	-0.13	0.00	-0.10	-0.25
Foreign reserves/ imports (months)	2.82	4.68	3.35	4.80	2.95	2.57	6.40	7.43
Changes from last year (Pt)	-0.05	0.43	-0.12	0.27	-0.68	0.18	-0.55	0.54
Foreign debt outstanding (100 million euros)	860	1443	550	183	199	147	522	220
Foreign debt (of nominal GDP)	82.7	42.3	39.1	86.0	64.3	91.9	40.9	69.9
Changes from last year (Pt)	+3.8	+3.3	+6.2	+5.9	+6.7	+6.0	+4.2	+11.8

Note: The data of the ratio of the short-term debt in foreign Reserves used 08.Q2. The data for Hungary and Estonia used 08.Q1. Foreign reserves/imports, reserves in September, 2008, imports in 08.Q2. (the average of last 4 terms) Imports stands for good, service and income payments. Foreign debt is in 08.Q2. The items in gray are “requiring attention”.