The difficult marriage between the RER and its fundamentals: Have they broken up after the crisis?

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Introduction

- PPP(A) establishes the RER should be 1 and the PPP(R) establishes that the RER should be constant.
- Fail! Wrong! It doesn’t happen.
- Maybe a *qualified* version.
- Then we need to search for the variables which can cointegrated with the RER.
- How about the functional form?
- Why is it important? (you tell me) ☺

Introduction (cont'd)

- In this paper we analyse the relationship between the RERs of the EU28 and their main fundamentals, and how the relationships may have suffered from:
  - changes in the form of structural breaks,
  - the impact of appreciations or depreciations, and
  - the possibility that the actual values of the RER may condition the relationships

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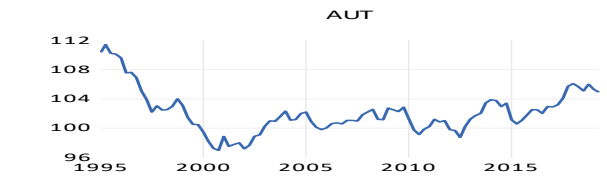
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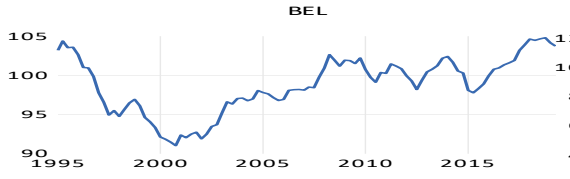
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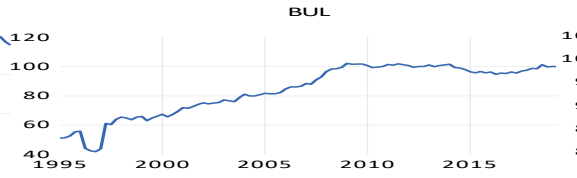
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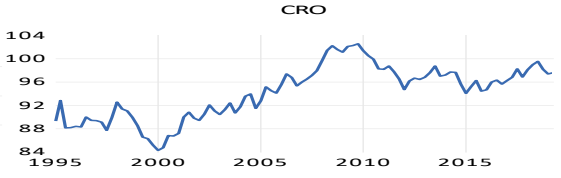
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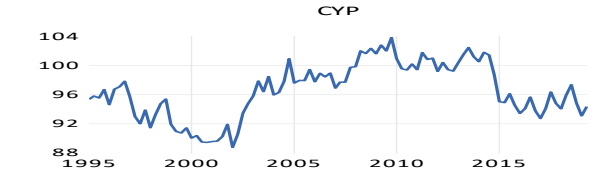
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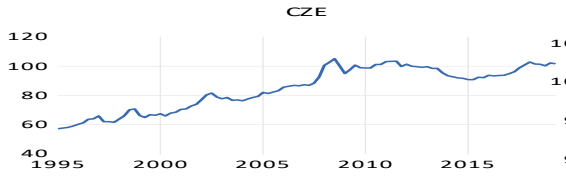
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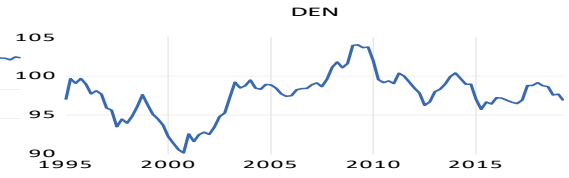
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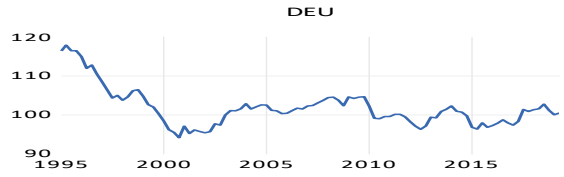
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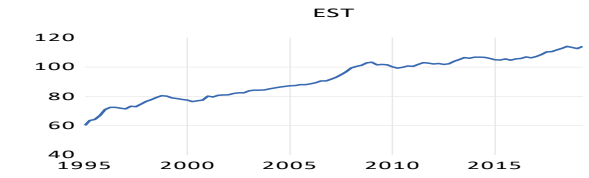
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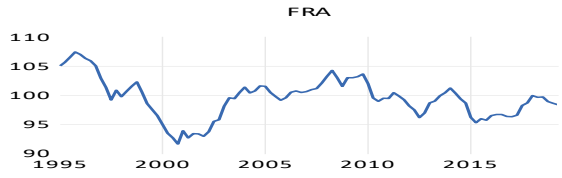
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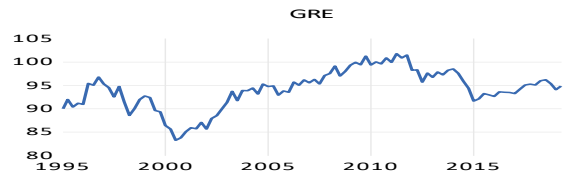
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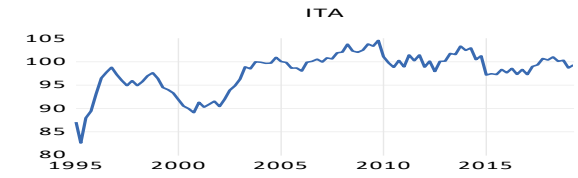
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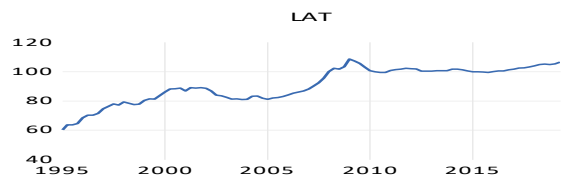
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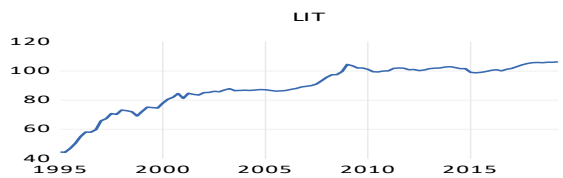
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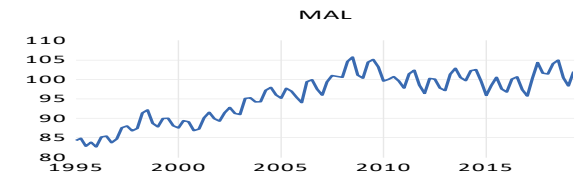
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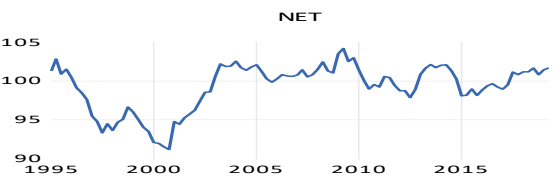
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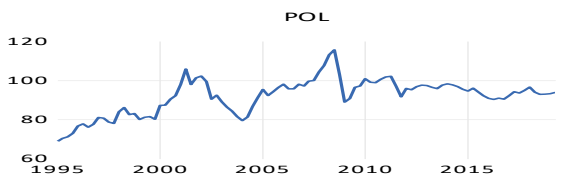
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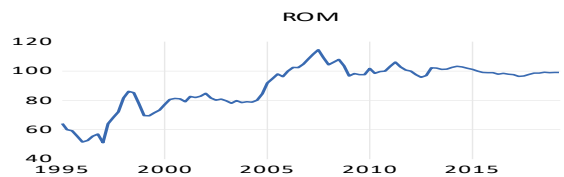
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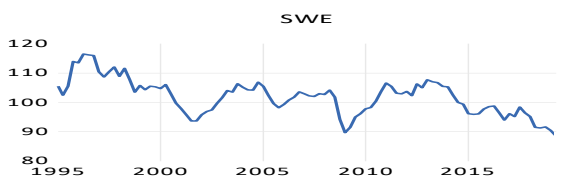
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Introduction (cont'd)

- And what do we do in this paper?
  - Analyse the relationship between the RER and its fundamentals for the EU28 as a panel.
  - Perhaps the contribution lies on how we do it: We use linear and nonlinear models.
    - DOLS
    - BVAR
    - Quantile regressions

The model

- The DOLS by Stock and Watson (1993):

$$y_t = \beta_0 + \vec{\beta}_i X + \sum_{j=-q}^{p} \vec{\alpha}_j \Delta X_{t-j} + \varepsilon_t$$

NB: All models have been estimated three centred seasonal dummies.

The model (cont'd)

Our long-run equilibrium RER specification is as follows:

$$q_{ti} = c + \beta_1 ca_{ti} + \beta_2 gco_{ti} + \beta_3 gfcf_{ti} + \beta_4 op_{ti} + \beta_5 tot_{ti} + \beta_6 y_{ti} + \varepsilon_{ti} \qquad (1)$$

Variable	Description
q	Log of the real effective exchange rate (REER) deflated by the consumer price index for the main 37 trading industrial country partners. with an increase indicating an appreciation in real terms.
ca	Current account balance in % of GDP
gco	Log of real government consumption
gfcf	Log of real gross fix capital formation
op	Log of openness defined as the sum of export and imports as a proportion of the GDP
tot	Log of the terms of trade which is calculated as the ratio between export prices and import prices
y	Log of the real GDP

Due to some country-level data limitations our dataset. spanning $1995q1–2019q2$. is unbalanced. Data from Eurostat.

The model (cont'd)

$$q_{ti} = c_i + d2008 * (\beta_1 ca_{ti} + \beta_2 gco_{ti} + \beta_3 gfcf_{ti} + \beta_4 op_{ti} + \beta_5 tot_{ti} + \beta_6 y_{ti}) + d2008on * (\beta_7 ca_{ti} + \beta_8 gco_{ti} + \beta_9 gfcf_{ti} + \beta_{10} op_{ti} + \beta_{11} tot_{ti} + \beta_{12} y_{ti}) + \varepsilon_{ti} \quad (2)$$

$$q_{ti} = c_i + apre * (\beta_1 ca_{ti} + \beta_2 gco_{ti} + \beta_3 gfcf_{ti} + \beta_4 op_{ti} + \beta_5 tot_{ti} + \beta_6 y_{ti}) + depre * (\beta_7 ca_{ti} + \beta_8 gco_{ti} + \beta_9 gfcf_{ti} + \beta_{10} op_{ti} + \beta_{11} tot_{ti} + \beta_{12} y_{ti}) + \varepsilon_{ti} \quad (3)$$

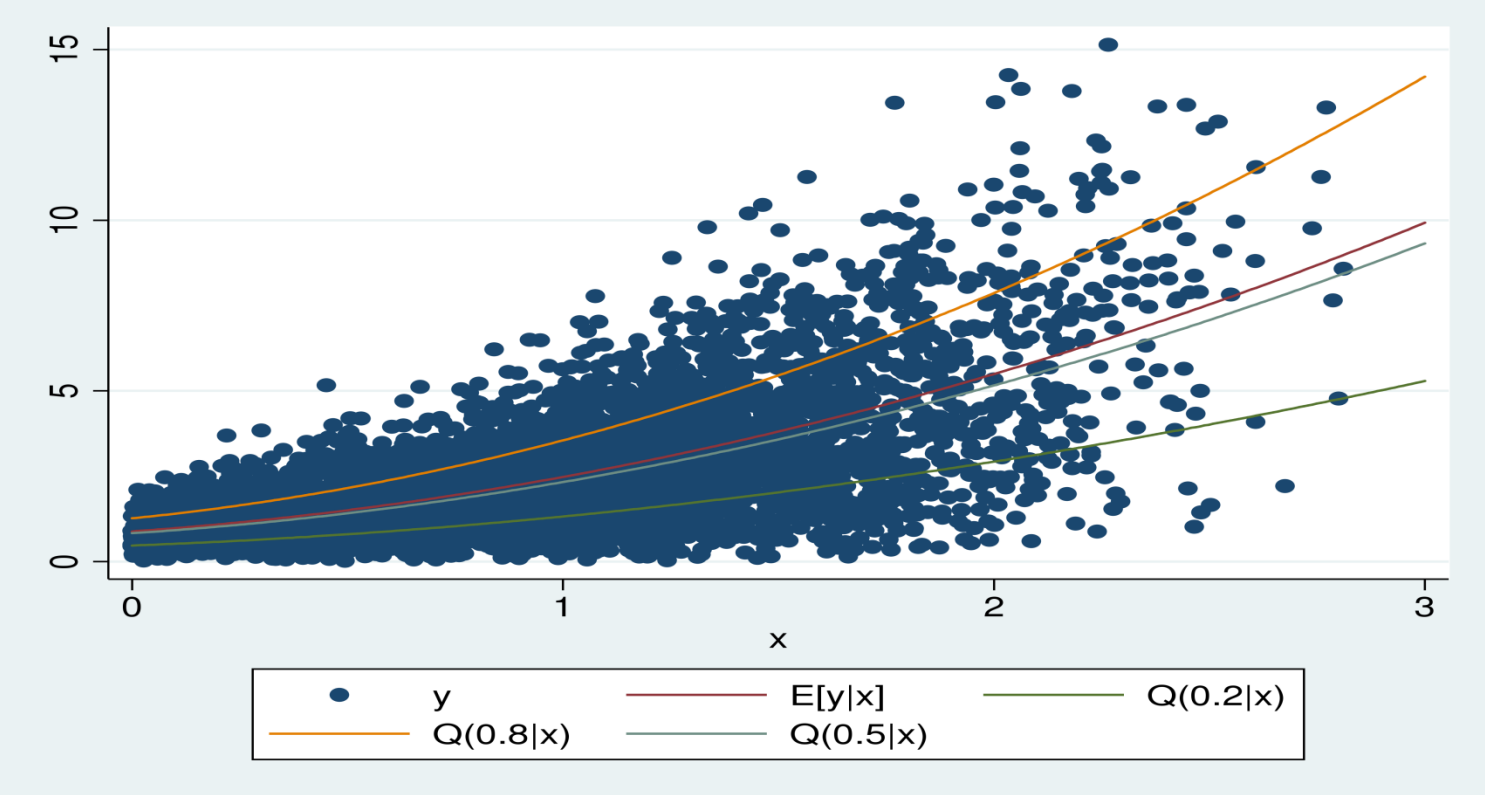
- Bayesian VAR approach

$$\delta_0 Y_t = \delta(L) Y_t + \varepsilon_t$$

$$\pi(\partial|Y) \propto f(Y|\partial)\pi(\partial)$$

The model (cont'd)

- Quantile regressions:



Results

Table 1: DOLS long run estimated

*** significant at the 1%, ** significant at the 5% and * significant at the 10%.

Variable	All	CEECs	EU15+2	All	CEECs	EU15+2	All	CEECs	EU15+2
		Pooled			Pooled (weighted)			Group Mean	
ca	0.15* (0.08)	0.52*** (0.13)	-0.08 (0.08)	-0.05 (0.05)	0.60*** (0.11)	-0.25*** (0.06)	0.06 (0.08)	0.05 (0.11)	0.06 (0.11)
gco	-0.02 (0.04)	-0.03 (0.07)	0.29*** (0.44)	-0.00 (0.03)	-0.05 (0.06)	0.28*** (0.03)	0.16*** (0.05)	0.10 (0.08)	0.19*** (0.07)
gfcf	0.07*** (0.03)	0.20*** (0.05)	-0.00 (0.02)	0.00 (0.02)	0.18*** (0.04)	-0.05*** (0.01)	0.08** (0.04)	0.11** (0.05)	0.07 (0.05)
op	0.15*** (0.02)	0.14*** (0.03)	-0.04* (0.02)	0.08*** (0.02)	0.10*** (0.03)	-0.05*** (0.01)	-0.03 (0.03)	0.18** (0.04)	-0.11*** (0.04)
tot	0.41*** (0.06)	-0.03 (0.09)	0.00 (0.07)	0.49*** (0.05)	0.06 (0.09)	0.07 (0.05)	0.35*** (0.09)	0.47*** (0.16)	0.27** (0.12)
y	0.00 (0.06)	0.03 (0.09)	-0.20*** (0.06)	0.11** (0.05)	0.08 (0.07)	-0.07* (0.05)	-0.10 (0.09)	-0.05 (0.10)	-0.12 (0.14)
Adj-R^2	0.63	0.75	0.53	0.62	0.75	0.51	-	-	-
No. obs.	2281	920	1361	2281	920	1361	2281	920	1361
No. countries	28	11	17	28	11	17	28	11	17

Variable	All	CEECs	EU15+2	All	CEECs	EU15+2	All	CEECs	EU15+2
Before 2008Q1		Pooled			Pooled (weighted)			Group Mean	
ca	0.38***	0.66***	-0.40***	0.24***	0.62***	-0.43***	0.32*	0.53**	0.17
	(0.11)	(0.18)	(0.15)	(0.09)	(0.15)	(0.12)	(0.17)	(0.22)	(0.25)
gco	0.06	0.00	0.50***	0.04	-0.07	0.44***	0.09	-0.19	0.28
	(0.05)	(0.07)	(0.06)	(0.03)	(0.07)	(0.06)	(0.20)	(0.23)	(0.29)
gfcf	0.15***	0.15**	-0.08*	0.11***	0.18***	-0.09**	-0.02	0.00	-0.03
	(0.04)	(0.06)	(0.05)	(0.03)	(0.06)	(0.04)	(0.06)	(0.07)	(0.10)
op	0.15***	0.08**	-0.00	0.04	0.03	-0.02	0.14**	0.31***	0.02
	(0.03)	(0.03)	(0.04)	(0.03)	(0.04)	(0.03)	(0.06)	(0.08)	(0.09)
tot	0.44***	0.20	-0.22**	0.54***	0.37***	-0.00	0.56***	0.88***	0.34
	(0.08)	(0.14)	(0.11)	(0.07)	(0.12)	(0.08)	(0.18)	(0.20)	(0.27)
y	-0.15*	-0.12	-0.38***	-0.03	0.06	-0.25***	-0.09	0.22	-0.31
	(0.08)	(0.23)	(0.09)	(0.06)	(0.10)	(0.08)	(0.21)	(0.25)	(0.32)
From 2008Q1									
ca	-0.13	-0.12	0.10	-0.05	0.08	-0.11	-0.03	0.11	-0.12
	(0.12)	(0.23)	(0.11)	(0.06)	(0.20)	(0.09)	(0.10)	(0.11)	(0.15)
gco	0.08	0.24***	0.21***	0.02	0.13*	0.20***	-0.04	0.07	-0.12
	(0.05)	(0.09)	(0.07)	(0.04)	(0.08)	(0.09)	(0.10)	(0.11)	(0.14)
gfcf	0.03	0.07	0.04	0.03	0.12**	-0.02	0.06	0.05	0.07
	(0.04)	(0.06)	(0.03)	(0.03)	(0.06)	(0.03)	(0.04)	(0.05)	(0.07)
op	0.18***	0.10*	-0.06	0.03	0.15***	-0.08**	-0.05	-0.07	-0.03
	(0.03)	(0.05)	(0.04)	(0.03)	(0.05)	(0.03)	(0.04)	(0.05)	(0.07)
tot	-0.28*	-0.30	0.11	-0.08	-0.25	0.16	-0.07	-0.28*	0.06
	(0.17)	(0.32)	(0.15)	(0.12)	(0.27)	(0.12)	(0.11)	(0.16)	(0.15)
y	-0.06	0.03	-0.22**	0.06	-0.06	-0.11	-0.03	-0.03	-0.03
	(0.07)	(0.09)	(0.09)	(0.06)	(0.08)	(0.08)	(0.11)	(0.12)	(0.17)
Adj-R^2	0.71	0.81	0.63	0.68	0.80	0.59	-	-	-

Results

Table 3: DOLS long equality restrictions break 2008 model

	All	CEECs	EU15+2	All	CEECs	EU15+2	All	CEECs	EU+2
		Pooled			Pooled (weighted)			Group mean	
Test Statistic	P-value	P-value	P-value	P-value	P-value	P-value	P-value	P-value	P-value
F-statistic	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.07
Chi-square	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.07
Normalized Restriction (= 0)	Value (std. Error)	Value (std. Error)	Value (std. Error)	Value (std. Error)	Value (std. Error)	Value (std. Error)	Value (std. Error)	Value (std. Error)	Value (std. Error)
ca(t<2008Q1)-ca(t>2007Q4)	0.51 (0.14)	0.78 (0.25)	-0.49 (0.14)	0.28 (0.11)	0.54 (0.19)	-0.32 (0.11)	0.35 (0.20)	0.42 (0.24)	0.29 (0.30)
gco(t<2008Q1)-gco(t>2007Q4)	-0.02 (0.04)	-0.23 (0.07)	0.30 (0.05)	0.02 (0.03)	-0.21 (0.06)	0.24 (0.05)	0.13 (0.22)	-0.26 (0.25)	0.40 (0.32)
gfcf(t<2008Q1)-gfcf(t>2007Q4)	0.12 (0.03)	0.08 (0.05)	-0.12 (0.04)	0.08 (0.03)	0.06 (0.05)	-0.07 (0.03)	-0.07 (0.07)	-0.05 (0.08)	-0.09 (0.10)
op(t<2008Q1)-op(t>2007Q4)	-0.03 (0.02)	-0.02 (0.04)	0.06 (0.02)	0.01 (0.02)	-0.12 (0.04)	0.06 (0.02)	0.19 (0.07)	0.37 (0.09)	0.05 (0.10)
tot(t<2008Q1)-tot(t>2007Q4)	0.72 (0.18)	0.49 (0.36)	-0.32 (0.19)	0.62 (0.13)	0.63 (0.30)	-0.16 (0.15)	0.64 (0.21)	1.17 (0.25)	0.28 (0.30)
y(t<2008Q1)-y(t>2007Q4)	-0.08 (0.04)	0.18 (0.08)	-0.15 (0.04)	-0.09 (0.26)	0.12 (0.05)	-0.14 (0.03)	-0.06 (0.22)	0.25 (0.27)	-0.27 (0.31)

Results

Table 5: DOLS long equality restrictions, asymmetric model

	All	CEECs	EU15+2	All	CEECs	EU15+2	All	CEECs	EU15+2
		Pooled			Pooled (weighted)			Group mean	
Test Statistic	P-value	P-value	P-value	P-value	P-value	P-value	P-value	P-value	P-value
F-statistic	0.09	0.20	0.02	0.10	0.17	0.00	0.00	0.02	0.04
Chi-square	0.09	0.20	0.02	0.10	0.17	0.00	0.00	0.01	0.03
Normalized Restriction (= 0)	Value (std. Error)	Value (std. Error)	Value (std. Error)	Value (std. Error)	Value (std. Error)	Value (std. Error)	Value (std. Error)	Value (std. Error)	Value (std. Error)
ca(apre)-ca(depre)	-0.00 (0.15)	0.01 (0.25)	0.02 (0.14)	0.01 (0.11)	-0.07 (0.21)	-0.11 (0.10)	-0.52 (0.17)	-0.32 (0.25)	-0.65 (0.23)
gco(apre)-gco(depre)	-0.06 (0.04)	-0.04 (0.07)	-0.04 (0.05)	-0.03 (0.03)	-0.04 (0.07)	0.00 (0.03)	-0.23 (0.08)	-0.29 (0.13)	-0.20 (0.10)
gfcf(apre)-gfcf(depre)	0.09 (0.04)	0.11 (0.06)	0.04 (0.04)	0.04 (0.03)	0.13 (0.06)	-0.00 (0.02)	0.05 (0.05)	0.20 (0.08)	-0.04 (0.06)
op(apre)-op(depre)	0.00 (0.02)	-0.04 (0.05)	-0.00 (0.01)	-0.00 (0.01)	-0.03 (0.04)	0.01 (0.01)	-0.00 (0.05)	-0.00 (0.08)	-0.00 (0.06)
tot(apre)-tot(depre)	-0.05 (0.14)	0.03 (0.22)	-0.16 (0.18)	0.01 (0.13)	0.00 (0.21)	-0.06 (0.11)	0.07 (0.22)	0.43 (0.35)	-0.15 (0.30)
y(apre)-y(depre)	-0.02 (0.04)	-0.05 (0.06)	0.00 (0.03)	-0.01 (0.02)	-0.07 (0.06)	-0.00 (0.02)	0.15 (0.09)	0.08 (0.12)	0.20 (0.12)

Figure 2: IRFs BVAR

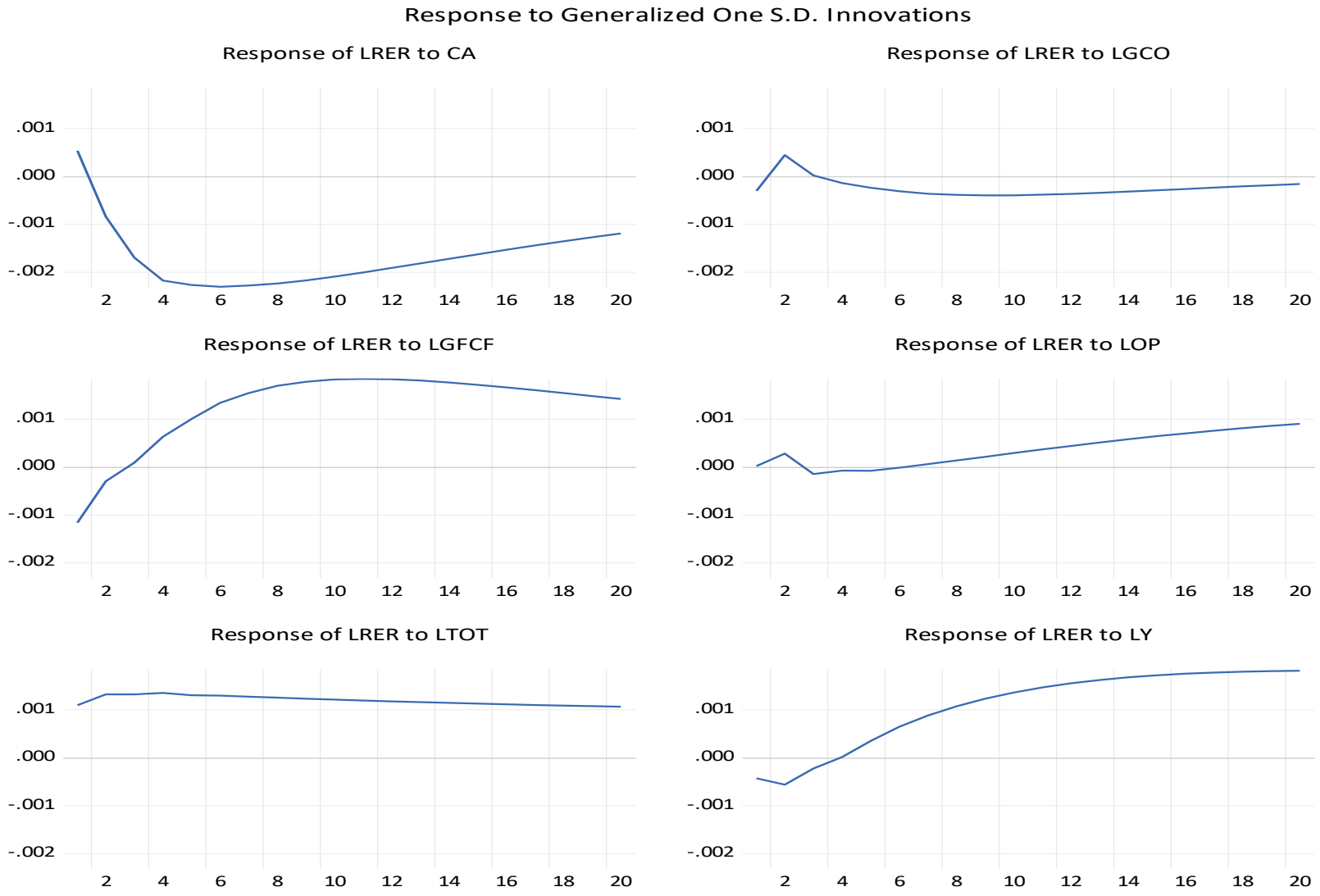


Figure 3: IRFs BVAR before 2008Q1

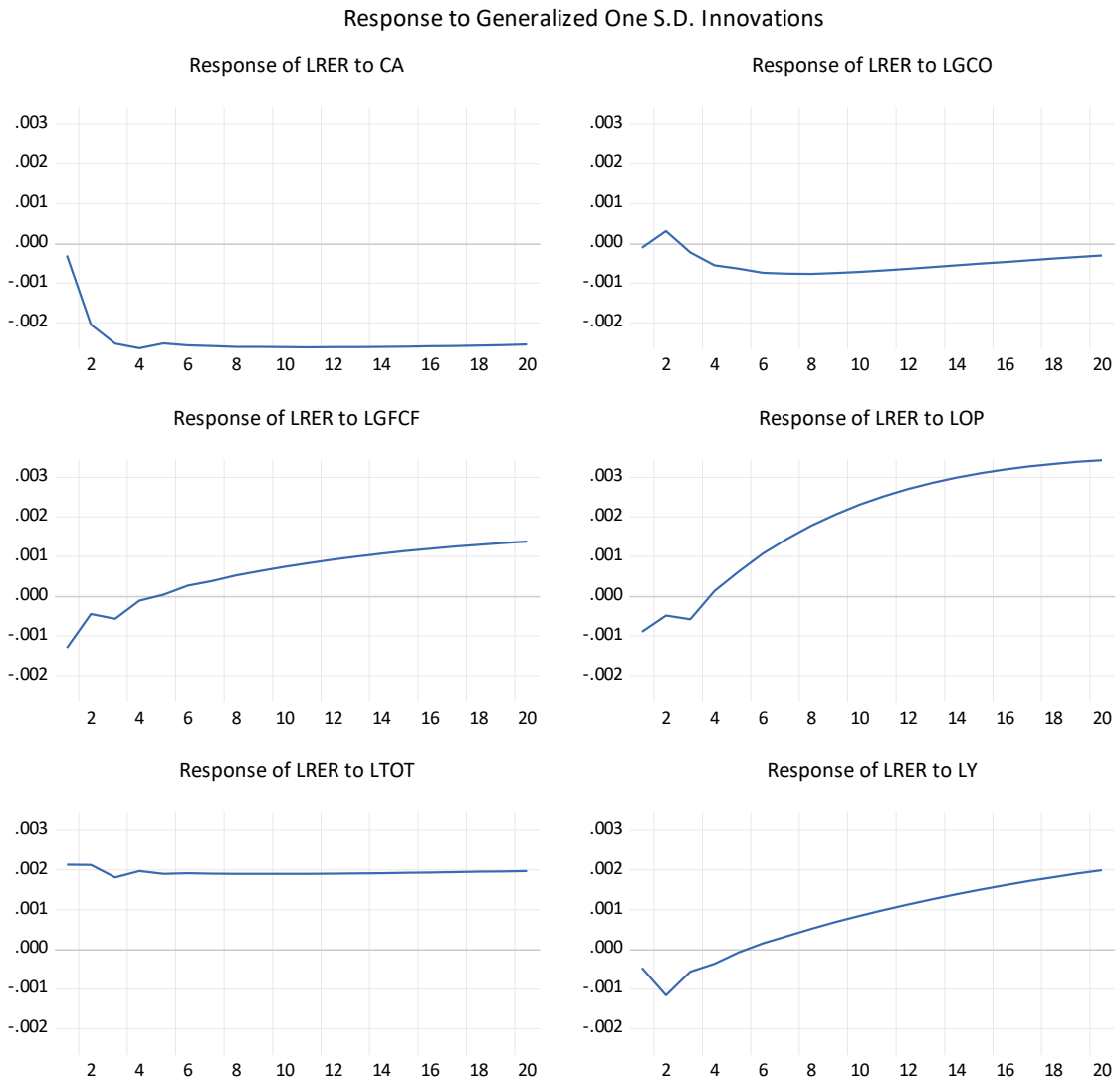


Figure 4: IRFs BVAR from 2008Q1

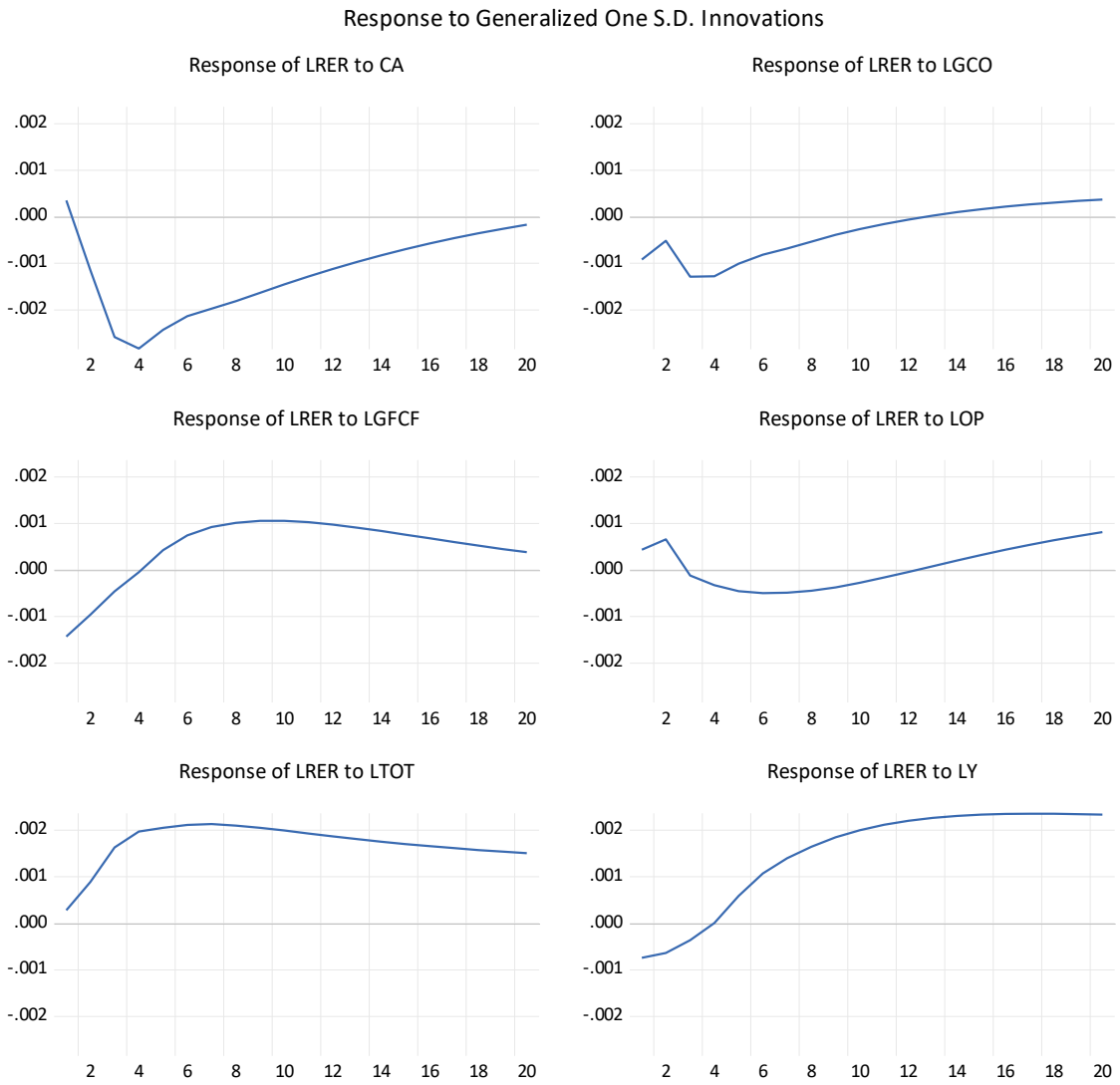


Figure 5: IRFs BVAR CEECs

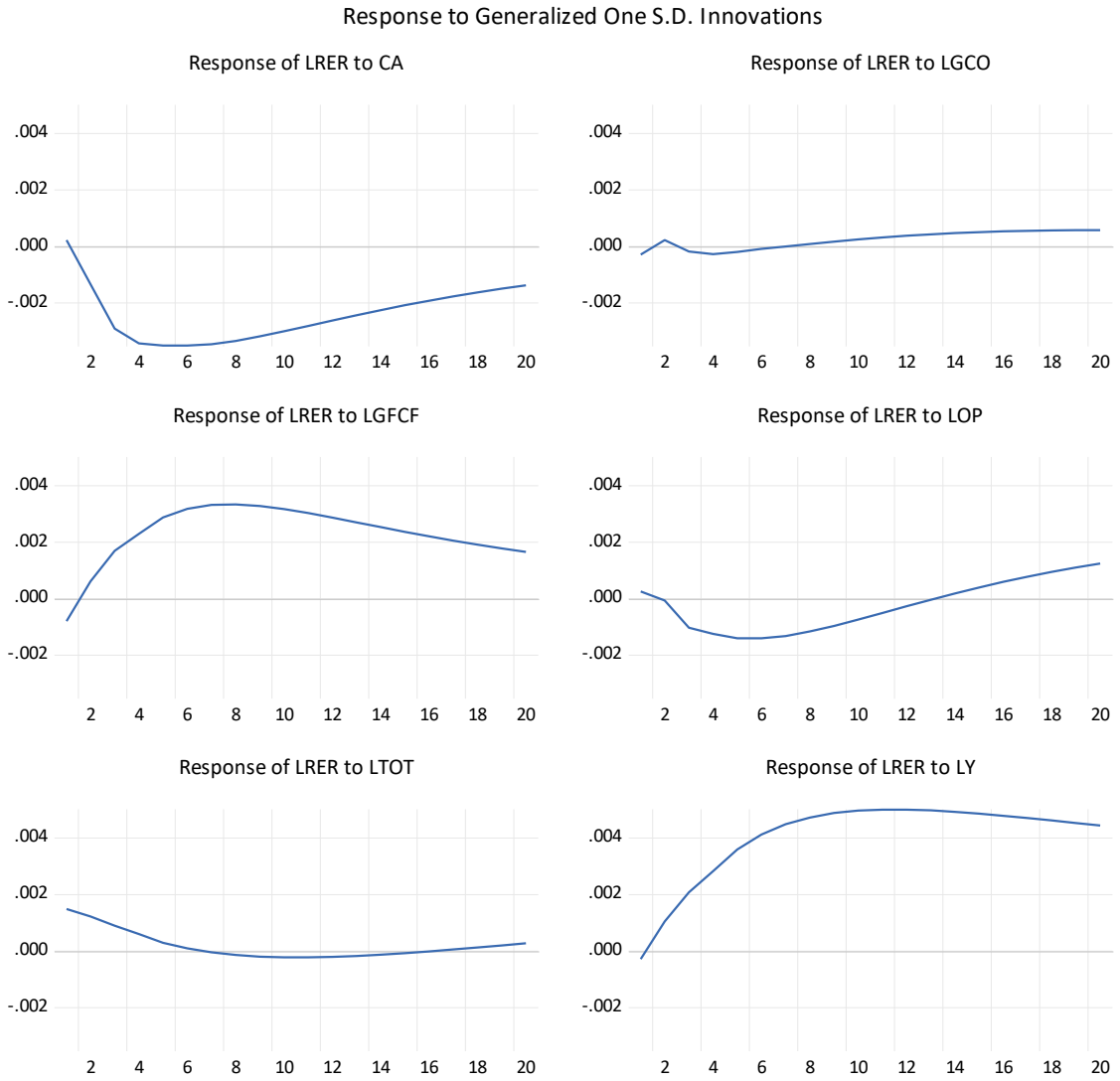


Figure 6: IRFs BVAR EU15+2

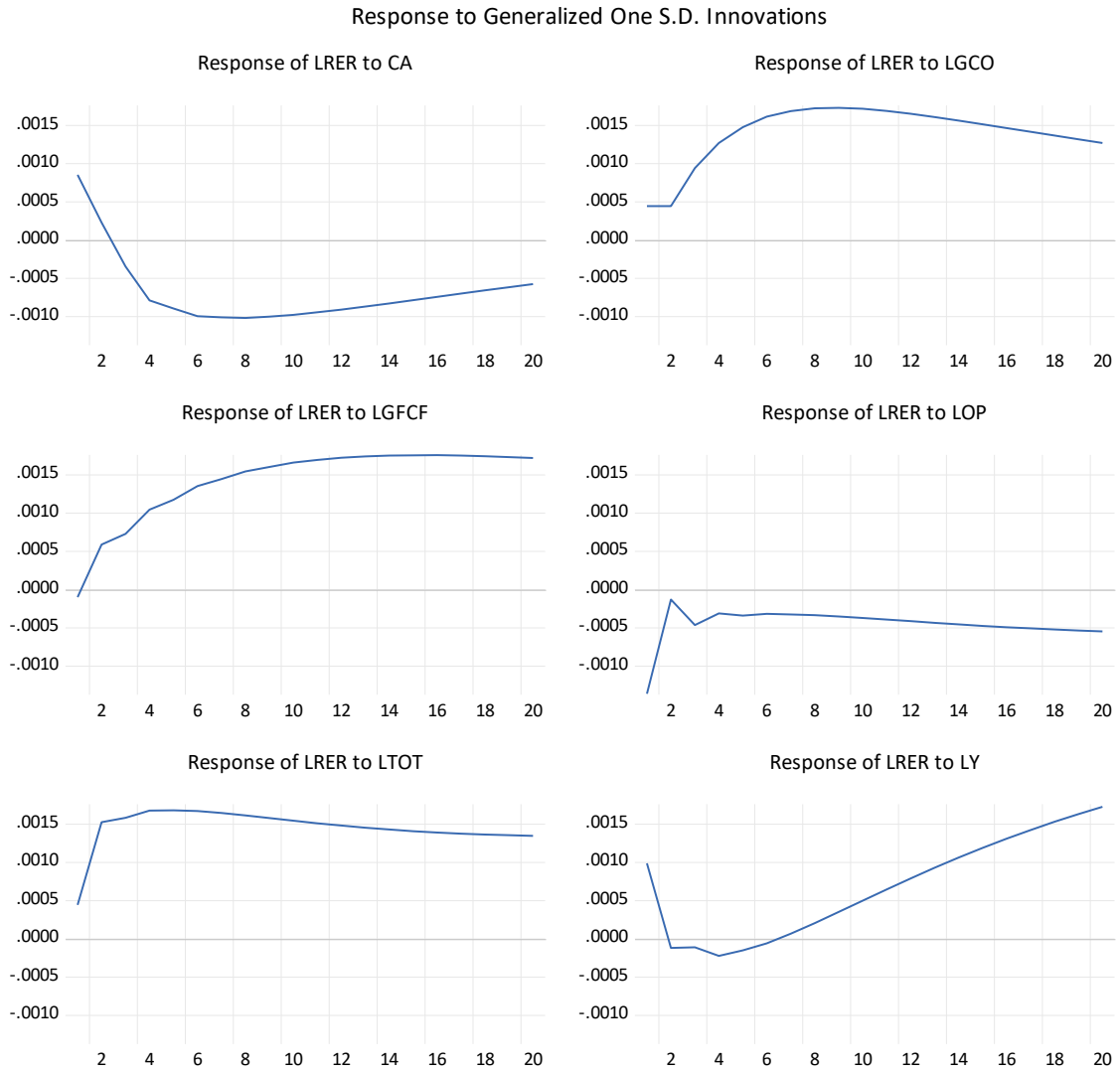
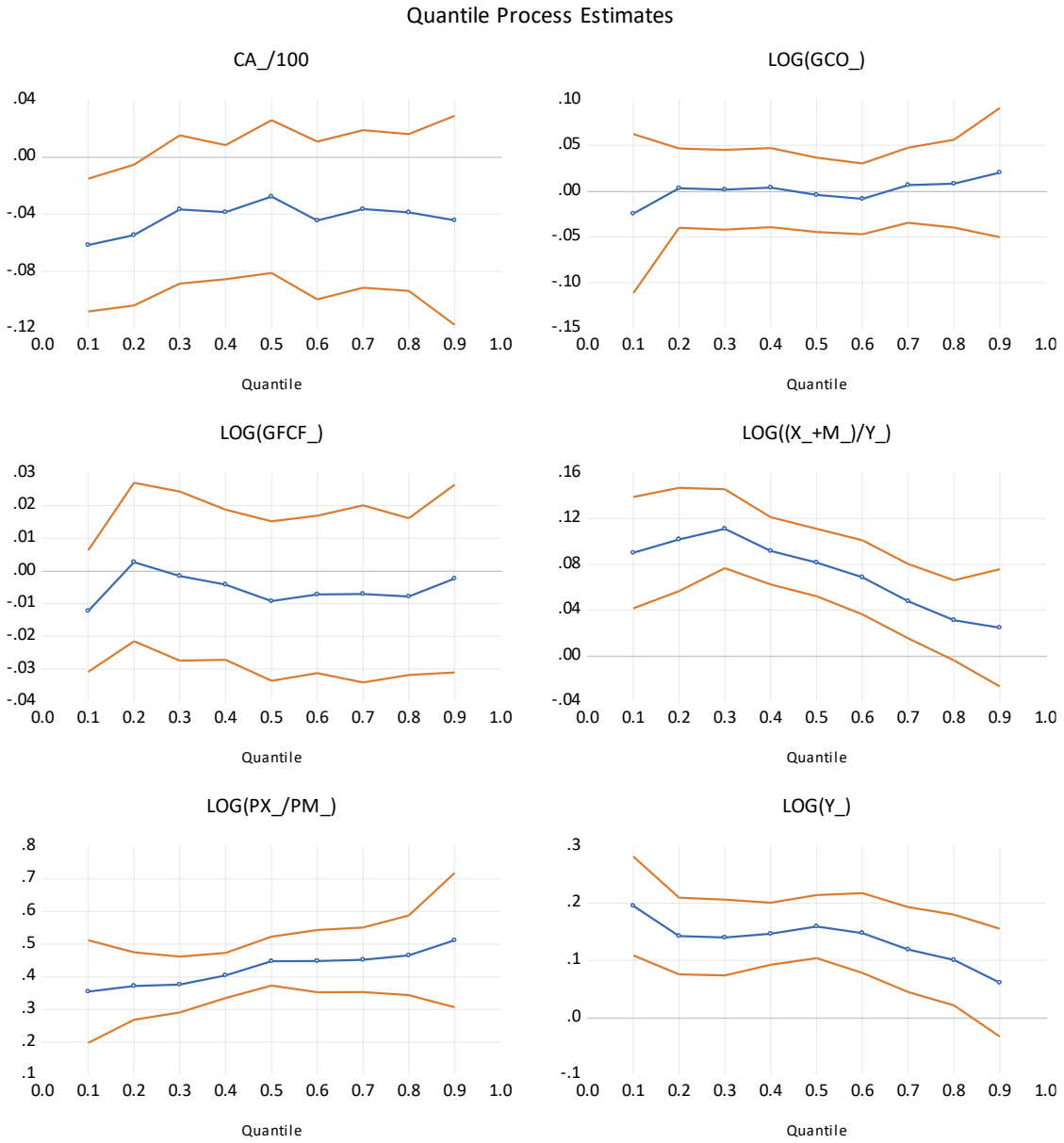


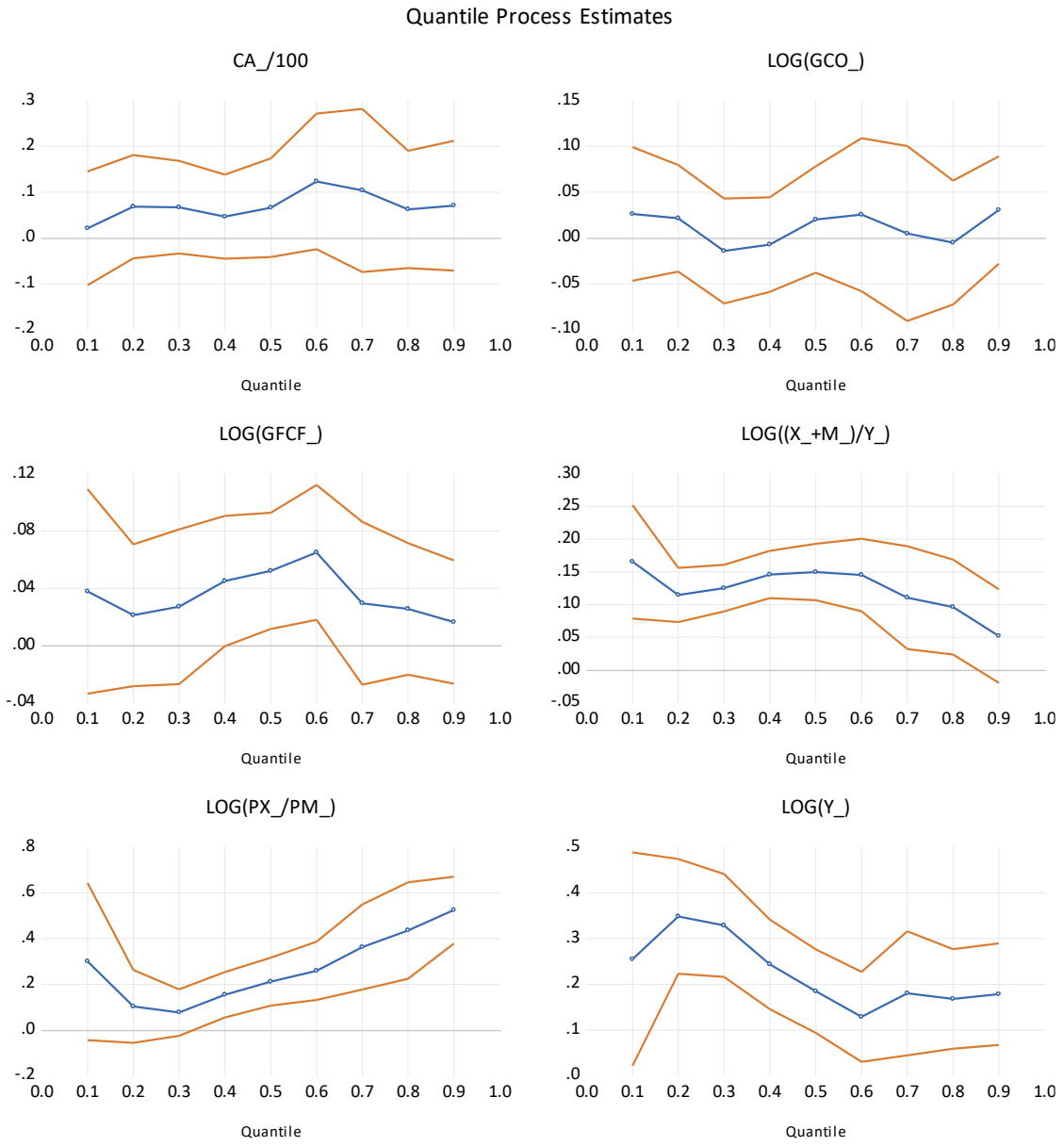
Figure 17: Quantile estimates



Test Summary		Chi-Sq. Statistic	Chi-Sq. d.f.	Prob.
Wald Test		34.04	12	0.00
Quantiles	Variable	Restr. Value	Std. Error	Prob.
0.25 0.5	ca	-0.02	0.03	0.44
	gco	0.02	0.02	0.45
	gfcf	0.02	0.02	0.36
	op	0.03	0.02	0.27
	tot	-0.07	0.05	0.16
	y	-0.03	0.04	0.38
0.5 0.75	ca	0.01	0.03	0.76
	gco	-0.01	0.02	0.74
	gfcf	0.00	0.01	0.77
	op	0.04	0.01	0.01
	tot	0.01	0.05	0.78
	y	0.04	0.03	0.18

Test Summary		Chi-Sq, Statistic	Chi-Sq, d,f,	Prob,
Wald Test		10.29	6	0.11
Quantiles	Variable	Restr. Value	Std. Error	Prob.
0.25 0.75	ca	-0.03	0.04	0.49
	gco	0.02	0.03	0.49
	gfcf	0.02	0.02	0.41
	op	-0.01	0.03	0.74
	tot	-0.08	0.07	0.26
	y	-0.08	0.05	0.14

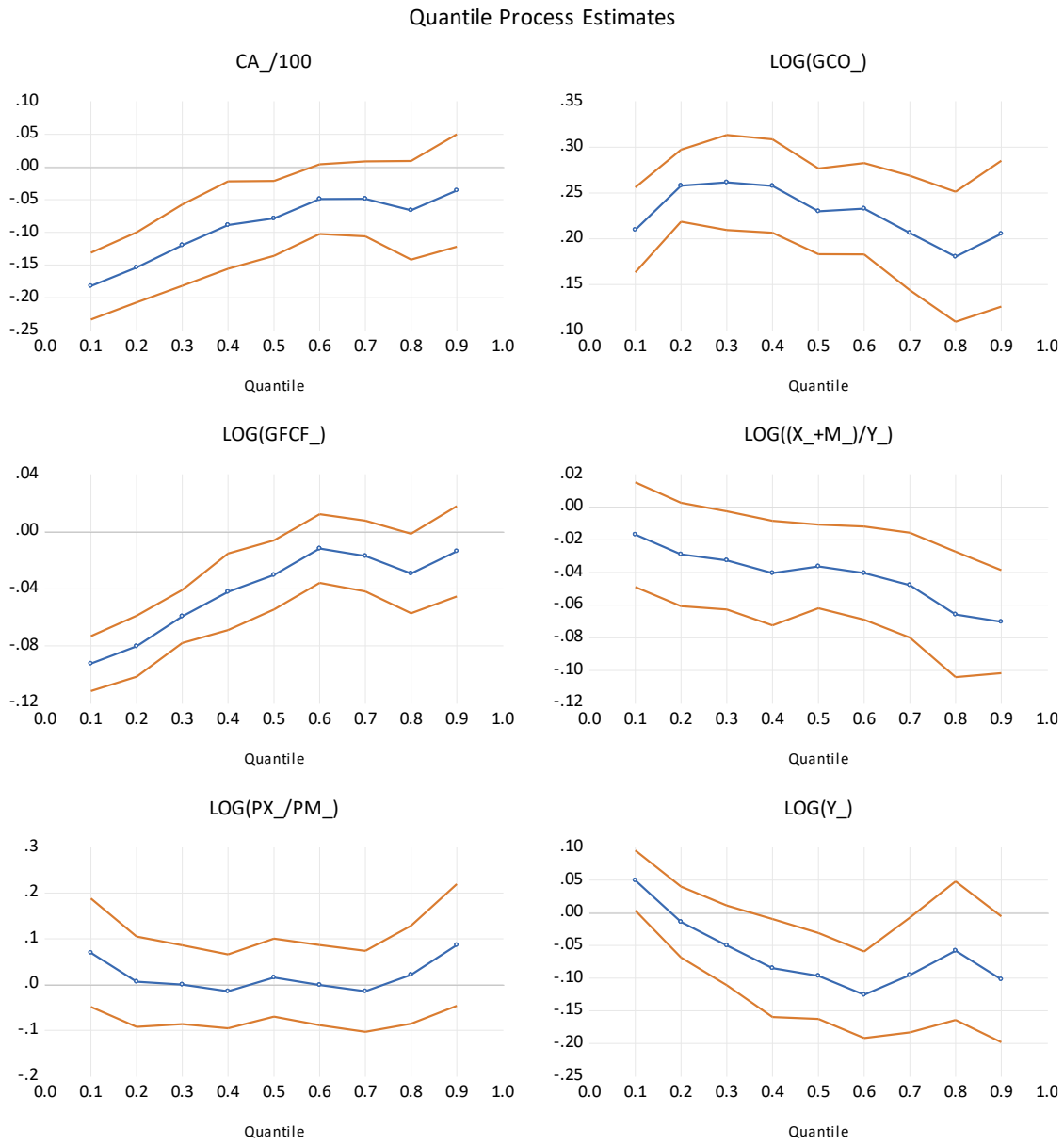
Figure 18: Quantile estimates CEECs



Test Summary		Chi-Sq. Statistic	Chi-Sq. d.f.	Prob.
Wald Test		36.44	12	0.00
Quantiles	Variable	Restr. Value	Std. Error	Prob.
0.25 0.5	ca	0.01	0.05	0.78
	gco	-0.02	0.03	0.59
	gfcf	-0.01	0.02	0.60
	op	-0.03	0.02	0.12
	tot	-0.14	0.05	0.01
	y	0.14	0.05	0.01
0.5 0.75	ca	0.14	0.05	0.01
	gco	-0.03	0.09	0.76
	gfcf	0.03	0.04	0.50
	op	0.03	0.03	0.22
	tot	0.05	0.05	0.31
	y	-0.18	0.20	0.38

Test Summary		Chi-Sq. Statistic	Chi-Sq. d.f.	Prob.
Wald Test		5.53	6	0.47
Quantiles	Variable	Restr. Value	Std. Error	Prob.
0.25 0.75	ca	0.04	0.10	0.68
	gco	-0.04	0.05	0.40
	gfcf	-0.04	0.03	0.21
	op	-0.08	0.06	0.14
	tot	0.04	0.21	0.86
	ca	0.14	0.09	0.12

Figure 19: Quantile estimates EU15+2



Test Summary		Chi-Sq. Statistic	Chi-Sq. d.f.	Prob.
Wald Test		50.26	12	0.00
Quantiles	Variable	Restr. Value	Std. Error	Prob.
0.25 0.5	ca	-0.06	0.03	0.03
	gco	0.01	0.02	0.63
	gfcf	-0.04	0.01	0.00
	op	0.01	0.01	0.31
	tot	0.03	0.04	0.55
	y	0.08	0.03	0.01
0.5 0.75	ca	-0.02	0.04	0.67
	gco	0.04	0.03	0.19
	gfcf	0.00	0.01	0.81
	op	0.02	0.02	0.33
	tot	0.01	0.04	0.78
	y	-0.03	0.05	0.55

Test Summary		Chi-Sq. Statistic	Chi-Sq. d.f.	Prob.
Wald Test		6.64	6	0.35
Quantiles	Variable	Restr. Value	Std. Error	Prob.
0.25 0.75	ca	-0.05	0.05	0.34
	gco	-0.03	0.04	0.46
	gfcf	-0.03	0.02	0.08
	op	0.00	0.02	0.92
	tot	0.01	0.07	0.84
	y	0.10	0.06	0.07

Conclusion

- In this paper we aim to analyse how the relationship between the EU28's RERs and their main fundamentals has changed for quarterly data for the period 1995Q1-2019Q2.
- We estimate a DOLS cointegrated relationship allowing for breaks in 2008Q1 and conditional on appreciations and depreciations of the real exchange rate, along with BVAR equations and IPVARs. We find that separating the central and eastern European countries from the remaining EU member states leaves them with different coefficients, and that the Great Recession did indeed have an impact on how the main RER fundamentals affect the long run equilibrium RER. We also find evidence of asymmetric effects for the EU15 + Cyprus and Malta, since the coefficients are different when the RER appreciates and depreciates.
- Finally, quantile regressions show that how far the RER is misaligned from parity also conditions the long-run equilibrium.

Thank you very much!