Remarks
on Okun's Law and Productivity

Willi Semmler New School for Social Research

=> Level form: $U_t - U_t^* = \beta\,(Y_t - Y_t^*) + \varepsilon_t,\ \beta < 0,$

=> Difference form: $\Delta U_t = \alpha + \beta\,\Delta Y_t + \omega_t,$

With:

$\alpha = -\beta\,\Delta Y^*$

⇒ Productivity growth, constant; Okun 1962

Y = .30 - .30X (r=.79)

According to this estimate, the unemployment rate will rise by 0.3 points from one quarter to the next if real GNP is unchanged, as secular gains in productivity and growth in the labor force push up the unemployment rate. For each

⇒ Productivity growth: short run=> creates unemployment (demand constrained economy, productivity growth faster than output growth, Okun =0)

⇒ Productivity growth: long run=> reduces unemployment (affecting long run technology, long run supply and cash flows of firms, more competitive)

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Literature:

- Blanchard and Solow (1994), Blanchard, Macroeconomics, also Gordon (2011)
- P. Chen and W. Semmler (2007): Productivity and Unemployment in the short and long run, SCEPA working paper (two time scales)
- M. Galegatti, J. Ramsey and W. Semmler, US (multiple time scales, wavelets)
- M. Galegatti, J. Ramsey and W. Semmler, 7 OECD countries (multiple time scales, wavelets)
- Haupt, Schnurbus and Semmler (2016), Drivers of growth…

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⇒ **Two time scales (Chen/Semmler), data: Francis/Ramey (2004)**

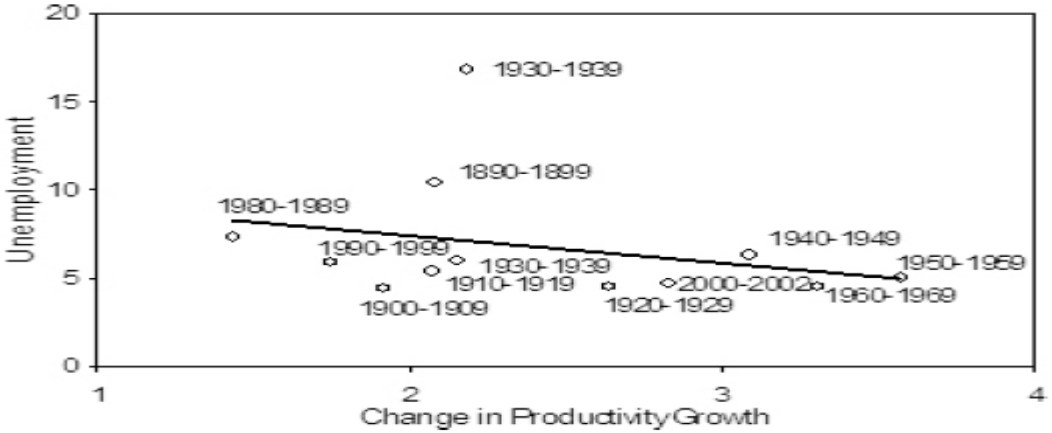

Figure 1: Productivity Growth vs. Unemployment from 1890-2002

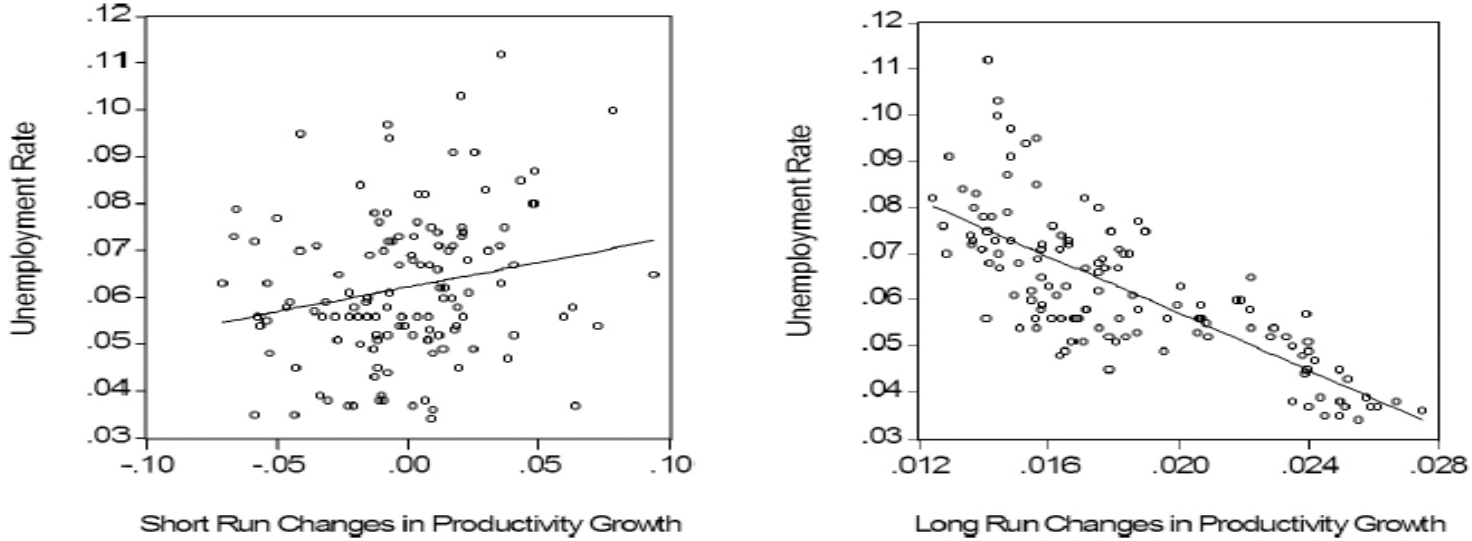

Figure 2: Post-WWII: Short and Long Run Effects (Quarterly)

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Using moving averages and **MLE** we have (best fit 59 quarters):

$$u_t = \alpha + \beta^L p_t^L + \epsilon_t^L + \beta^S p_t^S + \epsilon_t^S,$$

	Unempl.	Short Run	Long Run
Unempl.	1	0.209	-0.757
Short Run	0.209	1	-0.0398
Long Run	-0.757	-0.0398	1

Table 1: Correlations of Unemployment, Short and Long Run Prod. Growth

Variable	Coeff.	Std Error	T-Stat	Signif.
Constant	10.46171946	1.06978202	9.77930	0.00000000
p^L	-2.22763769	0.54176177	-4.11184	0.00007059
p^S	0.02648755	0.01382008	1.91660	0.05757167
ρ	0.81294997	0.05324226	15.26888	0.00000000

Table 2: Estimation Output for Linear Model

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Nonlinear model, non-parametric estimation (penalized splines)

$$u_t = \alpha + \beta^L \, p_t^L + \tilde{\beta}^L(t) \, p_t^L + \beta^S \, p_t^S + \tilde{\beta}^S(t) \, p_t^S + \epsilon_t, \qquad \hat{\beta}(t) = \hat{\beta} + \tilde{\beta}(t)$$

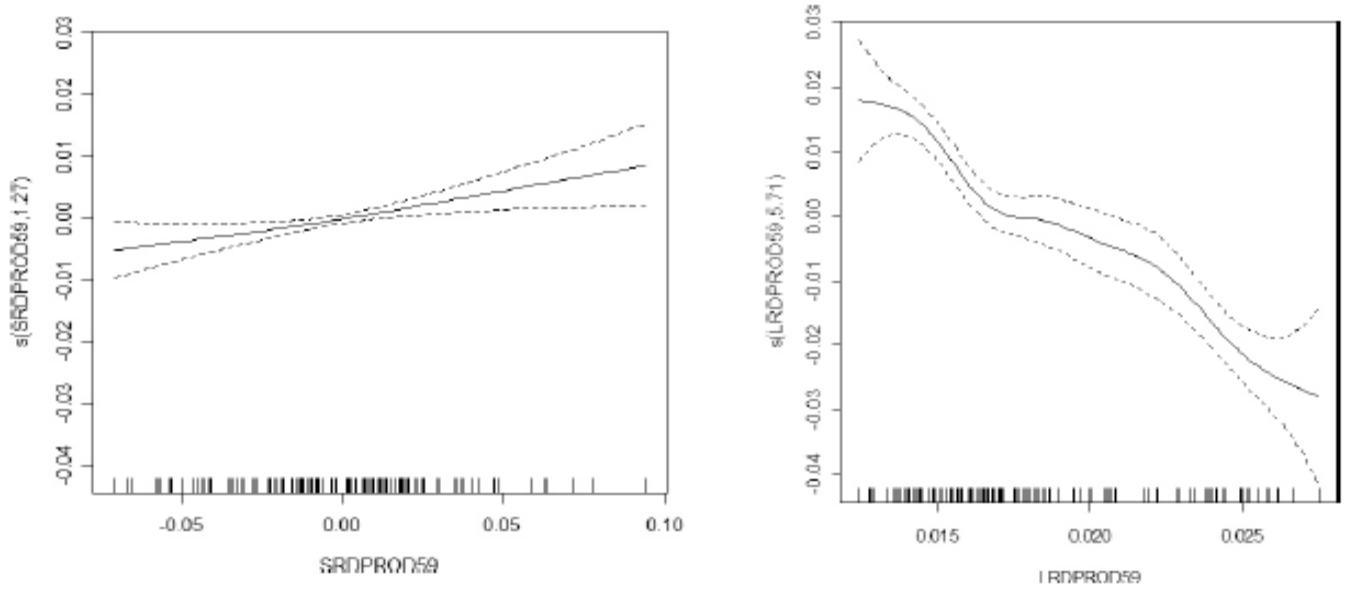

Figure 4: Non-Linear Effects of Short and Long Run Productivity Growth centered around their mean

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Multiple time scales (wavelets), see work with Galegatti and J. Ramsey
=> US case:

Table 1 Aggregate and time scale regression analysis (1948:1–2013:4)—OLS

$ur_t = \alpha + \beta \Delta lp_t + \epsilon_t$

	Aggregate	S_5	D_5	D_4	D_3	D_2	D_1
α_j	**5.7694**	**9.8850**	−5.13e−09	7.41e−10	−3.46e−09	−5.29e−10	2.26e−10
	(0.2248)	(0.2773)	(0.0616)	(0.0530)	(0.0259)	(0.0079)	(0.0018)
β_j	0.0257	**−1.8614**	**0.6862**	**0.5217**	**0.1902**	**0.0285**	**−0.0092**
	(0.0316)	(0.1166)	(0.1496)	(0.0557)	(0.0217)	(0.0101)	(0.0022)
$\overline{R}^2$	0.0027	0.8077	0.2375	0.4247	0.3777	0.0450	0.0735
S.E.	1.6646	0.5359	0.4606	0.4197	0.2671	0.1586	0.0704

Note: *HAC* standard errors in parenthesis, *S.E.* is the regression standard error
Regressors significant at 5 % in bold

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Multiple time scales (wavelets), see work with Galegatti and J. Ramsey
=> 7 OECD countries:

Table 1: *"Scale-by-scale" panel regression analysis (1962-2012)*

$$ur_{j,it} = \alpha_{j,i} + \beta_j \Delta lp_{j,it} + \epsilon_{j,it}$$

	Aggregate	S_3	D_3	D_2	D_1
β_j	**-0.599**	**-0.968**	*0.360*	**0.191**	0.002
	(-4.22)	(-4.16)	(1.70)	(2.48)	(0.28)
Adj. R^2	0.4170	0.6188	0.0399	0.0809	0.0001

Note: Fixed individual effects estimation of the productivity-unemployment relationship for the G7 countries with aggregate and scale-based panel datasets. t-statistics in parenthesis: 5% significance level in bold, 10% significance level in italic.

Some More General Remarks

- **Regime changes** (results from regime change models), shocks have asymmetric effects, use of MRVARs

  a) output shock: and employment multiplier stronger in recessions, Mittnik/Semmler (JEBO, 2012)

  b) productivity shock: has asymmetric effects on employment (greater negative effect of TFP shocks in recessions, less in expansions (Ferraresi/Roventini/Semmler, 2016)

  c) trend shift : long run declining productivity growth; since 2000 (2007-9); effects on unemployment? Is "natural rate" moving down
- **Structural change**: what employment effects will the shift toward more green sectors have? Mittnik et al. (2014), use of IO tables and a double-sided VAR, for 9 countries
- **Growth matters** for unemployment, but

  a) what are long run growth drivers, see Haupt et al (2016), leap frogging, role of technology, human capital, wages, resources…

  b) what are macro drivers of growth? (need of a large scale Okun model: output, inflation, interest rate, unemployment, credit flows).

Goethe's "Faust"

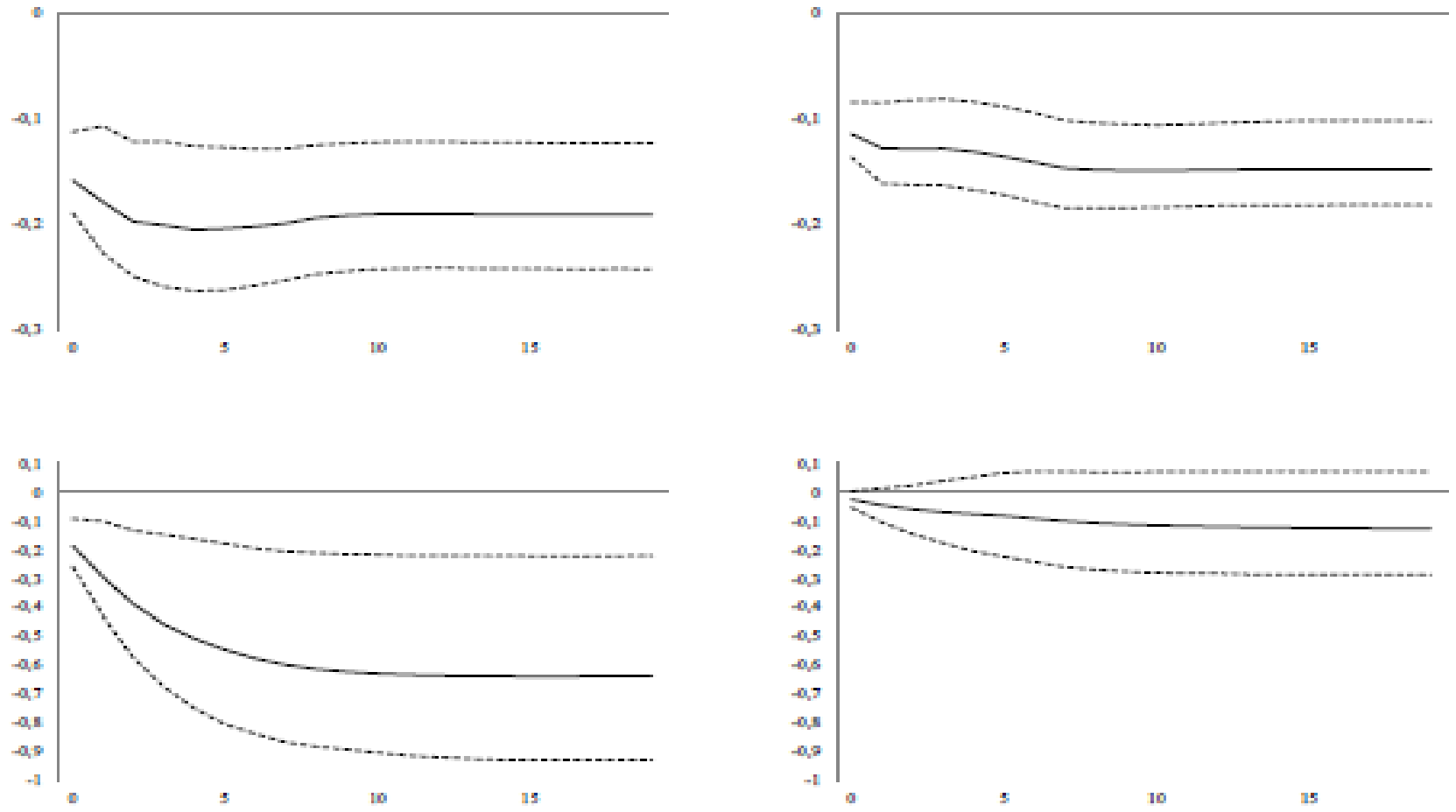
Essential is (real) growth:

„Zum Golde [**Wachstum]** drängt, am Golde [**Wachstum]** hängt doch alles"

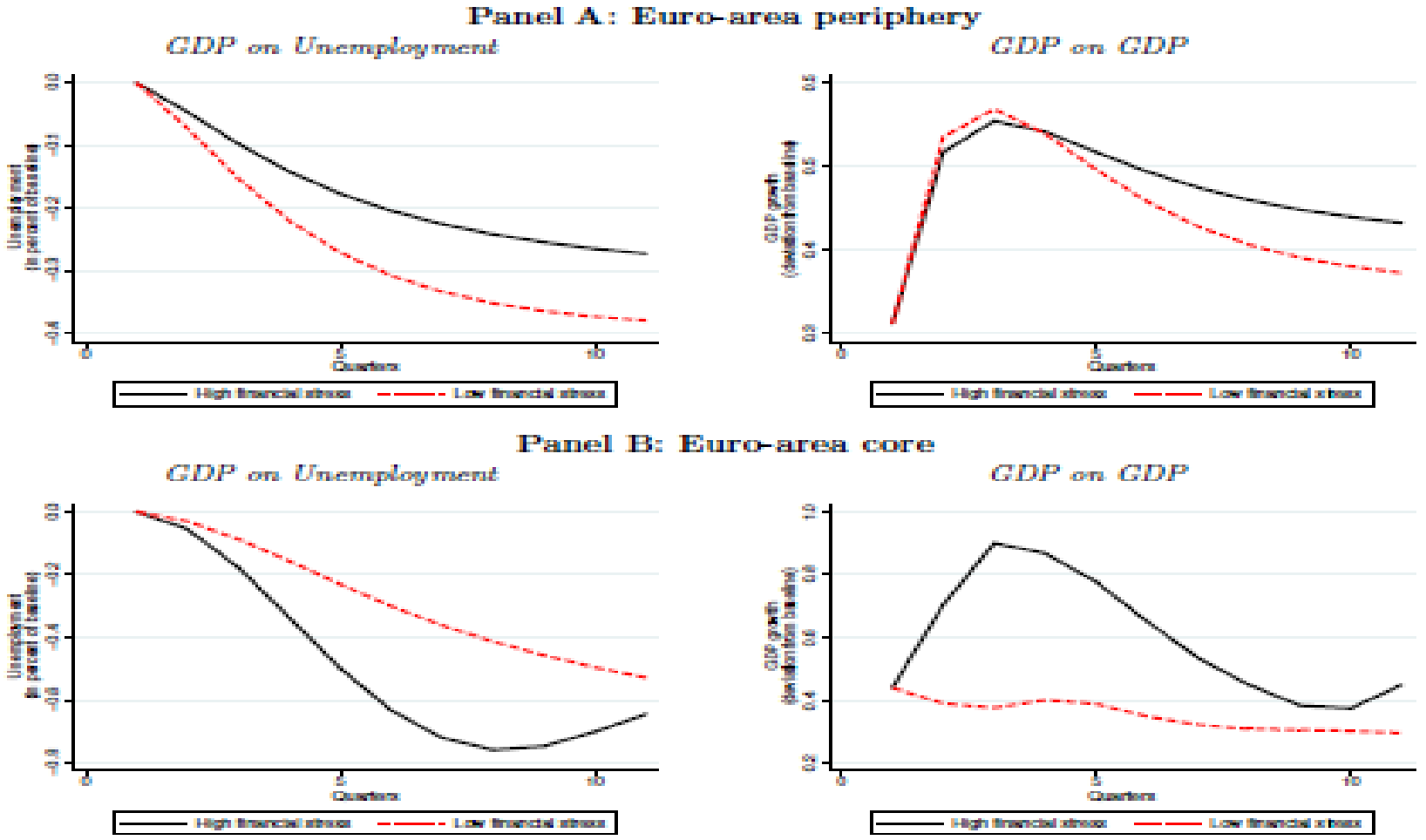
"To gold [growth] they tend, on gold [growth]depend, all things! Oh, poverty!"

Appendix 1: TFP shocks in growth regimes

Figure 3: Generalized impulse response functions. Cumulative response of average weekly hours (upper row) and of the number of employees (bottom row) with respect to a 1% standard deviation positive shock to adjusted TFP shock. Recessions (left column) vs. expansions (right column). Sample: 1957-2011.



Appendix 1: EU Regime dependent Okun's Law– Euro South vs Euro North



Note: Low financial stress regimes are represented in blue, high financial stress regimes in green.

Figure 15: Regime-dependent Okun's law, ZEW-FCI as exogenous transition variable: Euro area core vs. periphery

Appendix 1: Okun's law in a high dim macro model

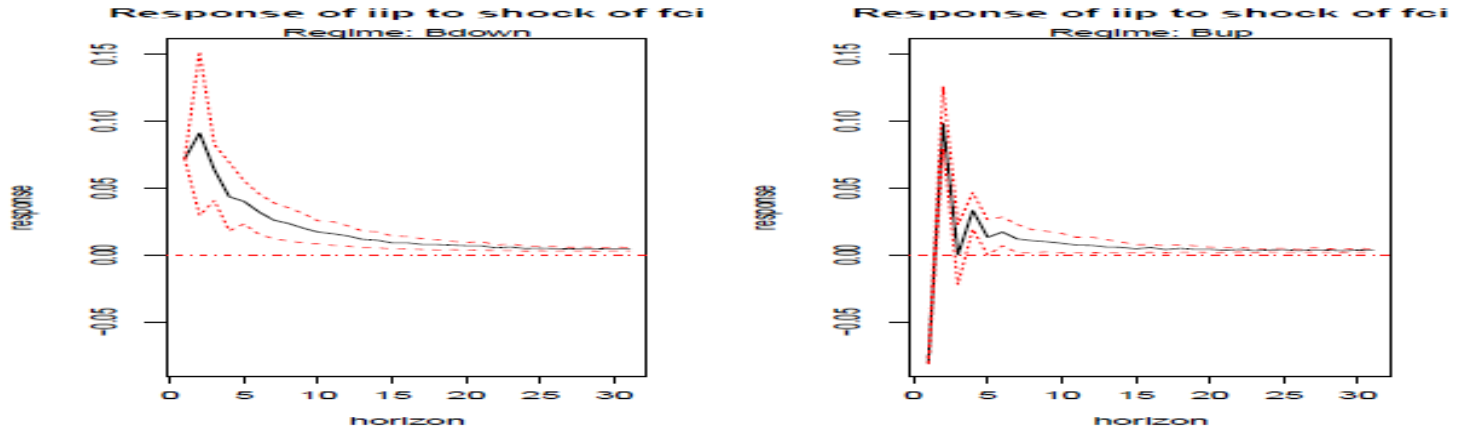


Figure 4: GIRF for Spain; shock of -1 s.d. to FCI, effect on change in iip; left graph: regime with ipp growth rates smaller than -0.4, right graph: regime with ipp growth rates larger than -0.4; red-dashed line signal the 75% percentile interval.

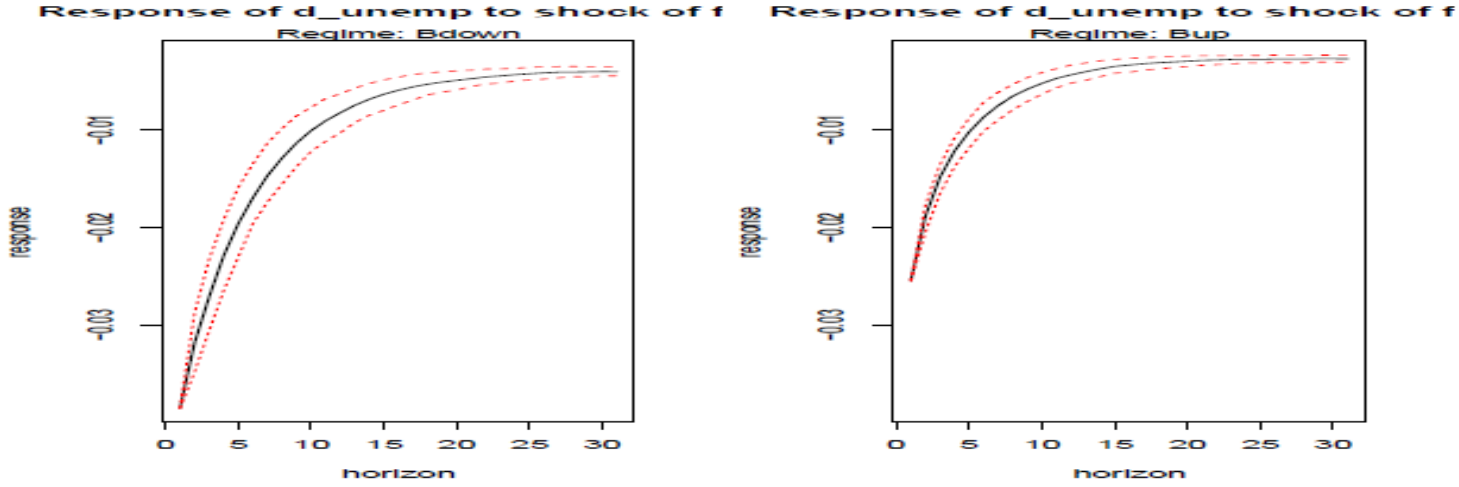


Figure 5: GIRF for Spain; shock of -1 s.d. to FCI, effect on change in unemployment; left graph: regime with ipp growth rates smaller than -0.4, right graph: regime with ipp growth rates larger than -0.4; red-dashed line shows the 75% percentile interval.