Unemployment Hysteresis and Cycle Asymmetry

A case study

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Motivation

- Two main charateristics of unemployment behaviour
  - Hysteresis: transitory shocks may have permanent effects on the unemployment rate (Blanchard and Summers, 1986)
  - Asymmetric behaviour: unemployment tends to rise faster than it decreases (Granger and Terasvirta, 1993)
- What's the theoretical motivation?
  - Insider-outsider model (e.g. Blanchard and Summers, 1986; Lindbeck and Snower, 1989)
  - Firing costs smaller than hiring costs (e.g. Bentolila and Bertola, 1990, Hamermesh and Pfann, 1996)
  - Labour Market Institutions, LMI (Layard et al., 1991)
- What are the most recent results from empirical studies?
  - Hysteresis hypothesis is confirmed for several Euro Area members, East and Central European as well as East Asian countries (Logecay and Tober, 2006; Lee et al. 2010; Cuestas et al., 2011 and Cheng et al., 2014)
  - Asymmetric behaviour is found for several OECD countries (Cancelo, 2007; Lin et. al., 2008, Franchi and Ordonez, 2011, Bardsen et al. 2012).
- Our aim is to capture the dynamics of the Portuguese unemployment rate.

Methodology for hysteresis and main results

- Standard unit root tests
- Testing for structural breaks (Perron, 1989)
- Unit root test with structural breaks (Lee and Strazicichi, 2003)

Panel A: Standard unit root tests

	with intercept		*with intercept and trend*	
	Level	First difference	Level	First difference
ADF	-1.195353 (2)	-3.927171***(1)	-2.142080 (2)	-6.226079*** (1)
PP	-0.248721	-6.025601***	-0.748309	-6.276827***
KPSS	0.620107**	0.383519 *	0.272075***	0.056098
MZa	-4.06425 (2)	-15.0218*** (1)	-6.47652 (2)	-18.3134** (1)
MZt	-1.07799 (2)	-2.52755** (1)	-1.63803 (2)	-2. 95154** (1)
MSB	0.26524* (2)	0.16826*** (1)	0.25292 (2)	0.16117** (1)
MPT	6.42010 (2)	2.42480** (1)	14.1237 (2)	5.43312** (1)

Panel B: Unit root tests with endogenous structural breaks

	Zivot-Andrews (1992)		Perron (1997)	
Model	LM stat	T_B	LM stat	T_B
Both	-3.6483	1999Q3	-3.6483	1999Q2

Panel C: Unit root tests with endogenous structural breaks in both H_0 and H_1

	LS (2004)				LS (2003)					
Model	$\hat{k}$	LM stat	T_B	λ	$\hat{k}$	LM stat	T_{1B}	T_{2B}	λ_1	λ_2
Crash	2	-2.6990	1986Q3	0.121	2	-2.8695	1986Q3	2002Q4	0.121	0.645
Break	2	-3.5430	1998Q3	0.508	2	-4.0553	1991Q4	1999Q2	0.290	0.532

AR(5) Model for the anual changes in Portuguese quarterly unemployment rate

$$\Delta U_t = -0.165 + 1.198\Delta U_{t-1} + 0.055\Delta U_{t-2} + 0.312\Delta U_{t-3} + 0.472\Delta U_{t-4} + 0.401\Delta U_{t-5} + 0.218D_1 + 0.218D_2 + \varepsilon_t$$

(0.0502) (0.1023) (0.1244) (0.125) (0.1443) (0.0738) (0.0659) (0.0293)

$$\sum \alpha_i = 0.868954$$

Diagnostic tests: Log-likelihood value: -45.72; **Standard error of residuals, ,** $\hat{\sigma}$: 0.37; **Autocorrelation 1-4:** $X^2(4)$ = 5.12[0.27]; **ARCH 4:** $X^2(4)$ = 1.80[0.77]; **Normality:** $X^2(2) = 4.28[0.12]$; **Heteroscedasticity,** F_{xixj}: $X^2(32)$ = 41.54[0.12]; **Heteroscedasticity,** $F_{x_i^2}$: $X^2(7)$= 21.00[0.00]; **RESET test:** F(1,106) = 0.35[0.56]

Figure : Main Results - hysteresis hypothesis

Methodology for cycle asymmetry and main results

- Nonlinear framework based on the seminal works of Granger and Terasvirta (1993) and Terasvirta (1994)

Parsimonious LSTAR model with annual change of cyclical unemployment as transition variable

$$\Delta_4 U_t = 2.11 - 0.15U_{t-1} + 1.93\Delta_4 U_{t-1} - 0.21\Delta_4 U_{t-3} - 0.48\Delta_4 U_{t-4} + 0.36\Delta_4 U_{t-5}$$
$$+ F(G)[-2.01 + 0.12U_{t-1} - 0.57\Delta_4 U_{t-1}] + \varepsilon_t$$

where $F(G) = \left(1 + \exp\left[\frac{-4.613(\Delta_4 UC_{t-1} - 0.6064)}{\hat{\sigma}(\Delta_4 UC_{t-1})}\right]\right)^{-1}$

Long-run properties: $F(G) = 0: \sum \phi_i = 1.6;\ \hat{u}_1 = 14.1\%;\ F(G) = 1: \sum \phi_i = 1.03;\ \hat{u}_2 = 3.3\%$

Diagnostic tests: AIC: -2.13; **SBIC**: -1.86; **Standard error of residuals, $\hat{\sigma}$**: 0.33; **Samples standard Deviation of $\Delta_4 UC_{t-1}$, $\hat{\sigma}(\Delta_4 UC_{t-1}) = 0.70$; Autocorrelation 1-4:** $F(4,100)$ = 1.04 [0.39]; **ARCH 4:** $X^2(4)$ =1.64 [0.17]; **Normality:** $X^2(2) = 0.21$ [0.90]; **Heteroscedasticity, F_{xixj}:** $X^2(39)$ = 49.63 [0.12]; **Heteroscedasticity, $F_{x_i^2}$:** $X^2(8)$= 12.67 [0.12];
RESET test: F(1,103) = 0.18 [0.67]

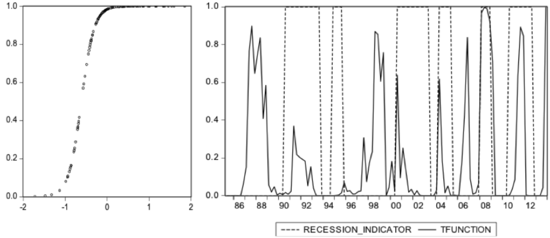

Figure : Main Results - Cycle Asymmetry

Conclusions

- The hysteresis hypothesis seems to be confirmed for the Portuguese unemployment rate;
  - These findings are supported in the literature by Chang et al. (2005) and Lin et al. (2008)
- Unemployment behaviour is better described by a nonlinear model (LSTAR) rather than by an AR(5) with:
  - annual change in the cyclical unemployment of quarterly unemployment as transition variable
  - two equilibrium unemployment regimes: low equilibrium unemployment (3.3%) and high equilibrium unemployment (14.1%)
- The transition between the two regimes appears to be rather fast
- From the beginning of the century changes between low and high unemployment regimes seem closely related with periods of expansion and recession.

Backup slides

- Backup slides

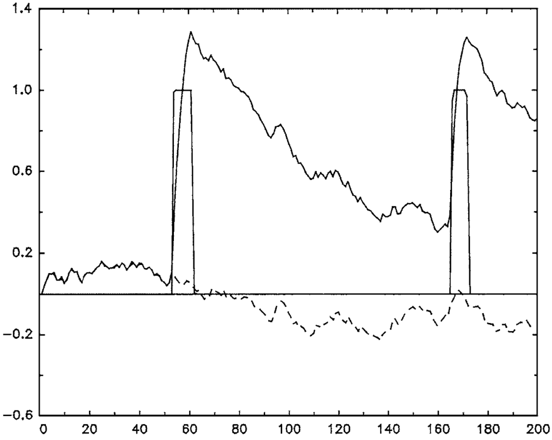

Figure : Skalin and Terasvirta (2002) Modelling Asymmetries and Moving Equilibria in Unemployment Rates

Backup slides

Figure : Quarterly Portuguese unemployment rate, seasonally-adjusted (1983:Q1-2013:Q4)

Backup slides

- Nonlinear framework based on the seminal works of Granger and Terasvirta (1993) and Terasvirta (1994)
  - STAR model can be formulated as:

$$\triangle u_t = \alpha + \beta u_{t-1} + \sum_{i=1}^{q} \phi_i \triangle u_{t-i} + \left(\tilde{\alpha} + \tilde{\beta} u_{t-1} + \sum_{i=1}^{q} \tilde{\phi}_i \triangle u_{t-i} \right) F\left(\gamma, \triangle u_{t-d} - c\right) + \varepsilon_t \quad (1)$$

  - Logistic smooth transition autoregressive model (LSTAR)

$$F\left(\gamma, \triangle u_{t-d} - c\right) = \left(1 + \exp\left[-\gamma\left\{\triangle u_{t-d} - c\right\}\right]\right)^{-1} \qquad (2)$$

  - exponential smooth transition autoregressive model (ESTAR)

$$F\left(\gamma, \triangle u_{t-d} - c\right) = 1 - \exp\left\{-\gamma\left(\triangle u_{t-d} - c\right)^2\right\} \qquad (3)$$

- Following Terasvirta (1994), we apply a sequence of tests to evalute the null of an AR(q) model against the alternative STAR model.

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- The tests are based on estimating the following auxiliary regression for a chosen set of values of the delay parameter, d:

$$\triangle u_t = \beta_0 + \sum_{i=1}^{q} \beta_{1i} \triangle u_{t-i} + \sum_{i=1}^{q} \beta_{2i} \triangle u_{t-i} \triangle u_{t-d} + \sum_{i=1}^{q} \beta_{3i} \triangle u_{t-i} \triangle u_{t-d}^2 + \sum_{i=1}^{q} \beta_{4i} \triangle u_{t-i} \triangle u_{t-d}^3 + v_t \quad (4)$$

- Testing an AR(q) model against a STAR model is equivalent to:

$$H_0 : \beta_{2i} = \beta_{3i} = \beta_{4i} = 0, i = 1, 2, ..., q \quad (5)$$

- If linearity is rejected, the next step is to test for LSTAR against ESTAR mdoel:

$$H_{04} : \beta_{4i} = 0, i = 1, 2, ..., q$$

$$H_{03} : \beta_{3i} = 0 | \beta_{4i} = 0, i = 1, 2, ..., q$$

Backup slides

Estimated model:

$$\Delta_4 U_t = 2.11 - 0.15U_{t-1} + 1.93\Delta_4 U_{t-1} - 0.21\Delta_4 U_{t-3} - 0.48\Delta_4 U_{t-4} + 0.36\Delta_4 U_{t-5}$$
$$+ F(G)[-2.01 + 0.12U_{t-1} - 0.57\Delta_4 U_{t-1}] + \varepsilon_t$$

where $F(G) = \left(1 + \exp\left[\frac{-4.613(\Delta_4 UC_{t-1} - 0.6064)}{\hat{\sigma}(\Delta_4 UC_{t-1})}\right]\right)^{-1}$

Sample: 1985:Q2-2013:Q4

Long-run properties:

$F(G) = 0\text{:} \sum \phi_i = 1.6;\ \hat{u}_1 = 14.1\%$

$F(G) = 1\text{:} \sum \phi_i = 1.03;\ \hat{u}_2 = 3.3\%$

Figure : Parsimonious LSTAR model with annual change in the cyclical unemployment of quarterly unemployment as transition variable

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Diagnostic tests:	
AIC	-2.12554
SBIC	-1.86298
Standard error of residuals, $\hat{\sigma}$	0.330169
Samples standard Deviation of $\Delta_4 UC_{t-1}$, $\hat{\sigma}(\Delta_4 UC_{t-1})$	0.702203
Autocorrelation 1 – 4:	$F(4,100) = 1.0400$ [0.39050]
ARCH 4	$X^2(4) = 1.635794$ [0.1706]
Normality:	$X^2(2) = 0.214470$ [0.898315]
Heteroscedasticity, F_{xixj}:	$X^2(39) = 49.62653$ [0.1185]
Heteroscedasticity, $F_{x_i^2}$	$X^2(8) = 12.67004$ [0.1219]
Model specification, RESET test:	F(1,103) = 0.1837 [0.6691]

Figure : Parsimonious LSTAR model with annual change in the cyclical unemployment of quarterly unemployment as transition variable

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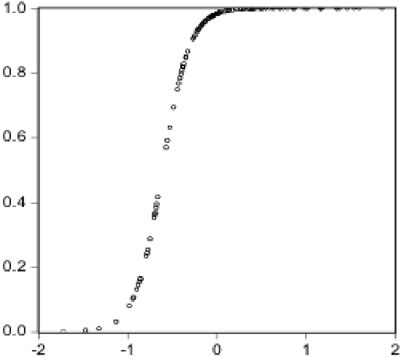

Figure : A cross plot of the transition function $\hat{F}$ (vertical axis) against the transition variable (horizontal axis). One dot represents at least one observation.

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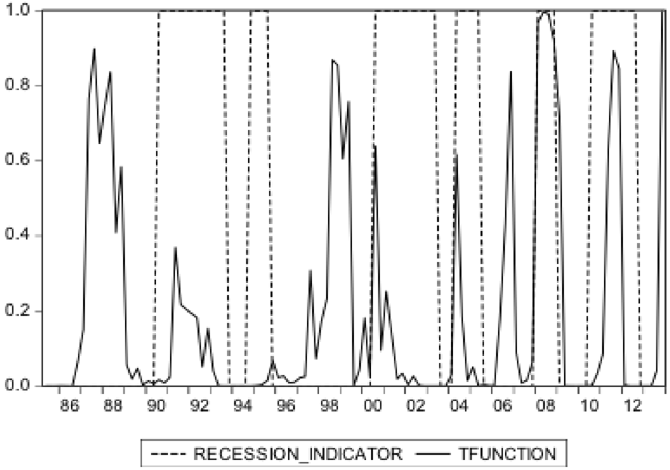

Figure : Transition function and "business cycle" for the Portuguese case

Backup slides

- Introduce LMI
  - Equilibrium unemployment
  - Transititon between regimes
- Analyse the impact of different size shocks on the two regimes and the role of LMI