GROWTH IN A TIME OF DEBT – EVIDENCE FROM THE UK

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June 22, 2015

ISEO Summer School 2015

Structure

- Literature & Research Question
- Data & Methodology
- Empirics & Results
- Conclusio

LITERATURE & RESEARCH QUESTION

Literature

- Financial crisis 2007/2008 & to European debt crisis
- Seminal paper by Reinhard & Rogoff 2010
  - *'Our main finding is that across both advanced countries and emerging markets, high debt/GDP levels (90% and above) are associated with notably lower growth outcomes.' (Reinhart and Rogoff, 2010, pp. 577)*
  - Paper generated a lot of controversy
  - Used to promote austerity measures

Research Question

Is there a linkage between the sovereign debt level and the GDP growth rate for the UK?

- Analyze the relationship between public debt (DoG) and the GDP growth rate (PGR) in a bivariate system using time-series application.
- Special emphasis on structural breaks.
- Is there a relationship in general? More specifically, did the UK austerity measures actually have an impact on economic growth?

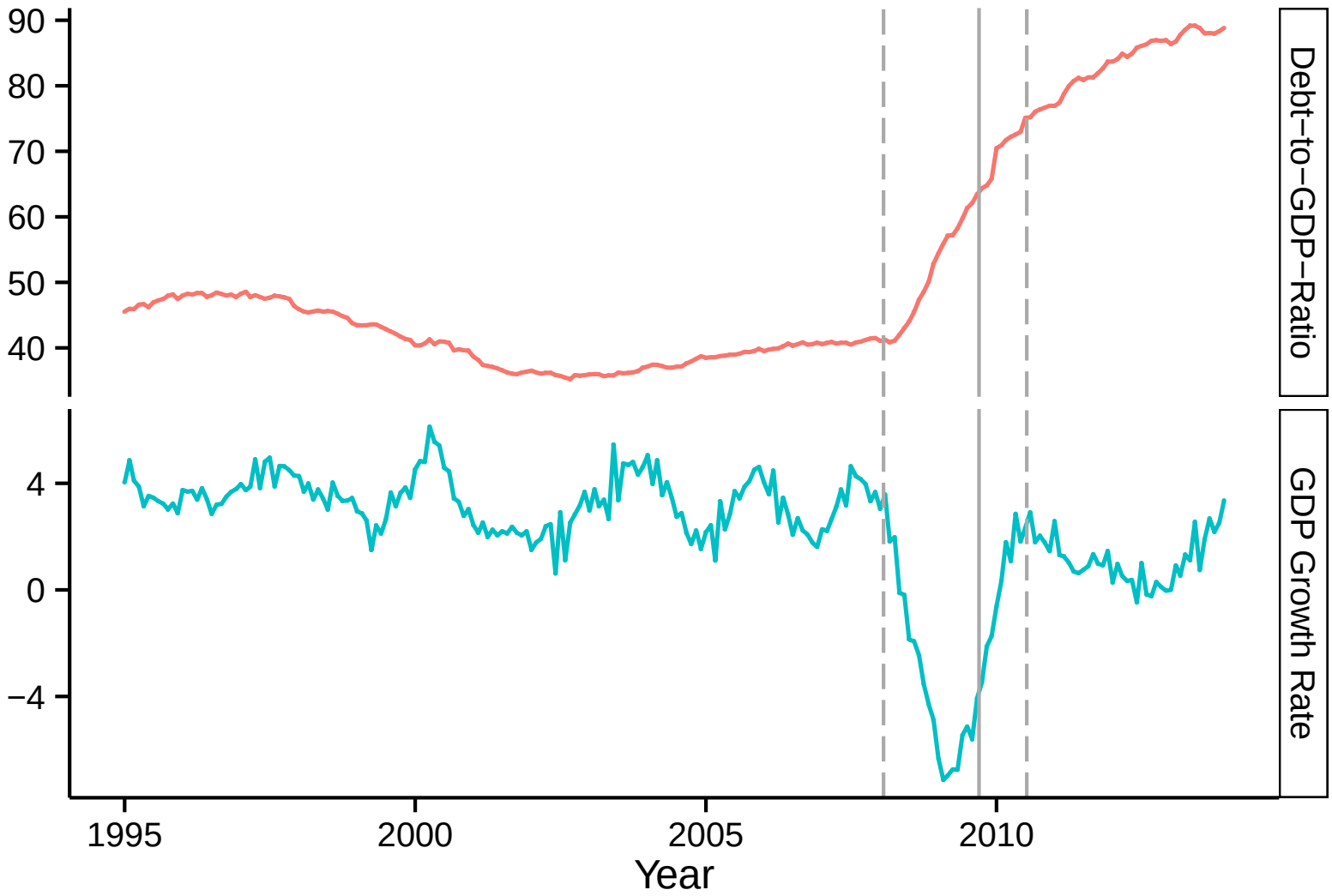
DATA & METHODOLOGY

Data

Uniquely derived monthly data set for the period of 1995M01 to 2013M12:

- Gross government debt ratio: '*general government total gross debt in percent of GDP at current prices*' from the **Quarterly Public Sector Debt** data from **OECD.StatExtracts** set
- GDP growth rates: estimated monthly GDP index provided by the **National Institute of Economic and Social Research (NIESR)**.

Data

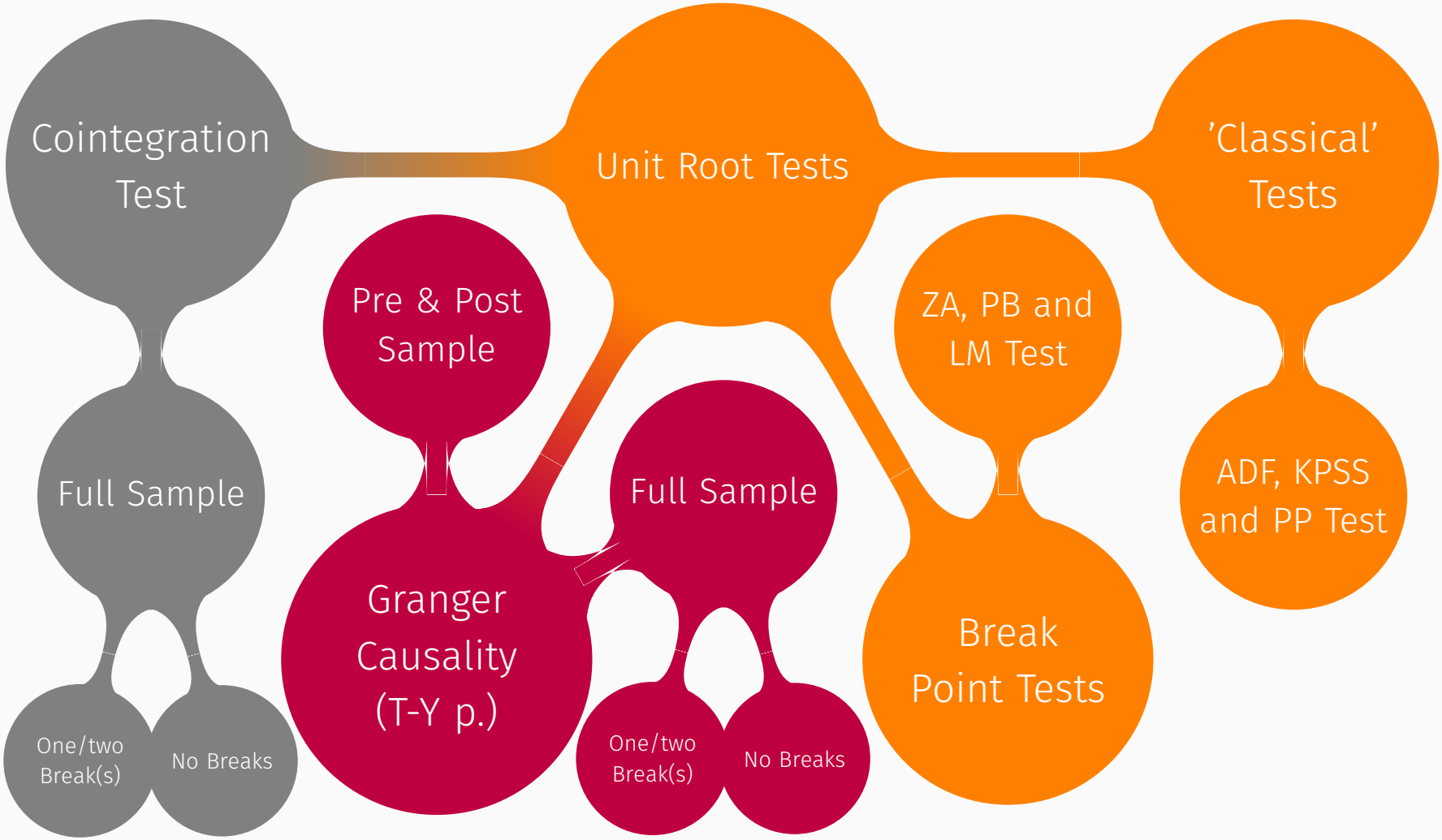

90
80
70
60
50
40
4
0
−4
1995
2000
2005
2010
Year
Debt−to−GDP−Ratio
GDP Growth Rate

Methodology

Unit roots and structural breaks: Nelson and Plosser (1982) & Perron (1989)
Given this and the crisis scenario of the analysis, put special emphasis on structural breaks:

- Tests for structural breaks
- Unit root tests with and without allowing for (a) endogenous structural break(s)
  - Zivot and Andrews (1992) 'ZA test' and Perron (1997) 'PB test'
  - Lee and Strazicich (2003) 'LM test'
- Given results, analysis of sub-periods
  - Granger causality tests by Toda and Yamamoto (1995) 'T-Y procedure'
  - Cointegration tests by Johansen et al. (2000)
  - Pre- & post-crisis periods as well as 'full sample'

Methodology: Sequential Testing Procedure



Methodology: The Toda Yamamoto (1995) procedure

1. Determine max. order of integration of series of interest, *m*.
2. Estimate unrestricted VAR(p) model in levels with *p* lags.
   - Autocorrelation and normality tests of the residuals. If necessary, include additional lags to the VAR system.
3. Add additional *m* lags in final set-up of the VAR system; will not be included in the final Wald test.
4. The VAR(p) specification of the system for both variables following Stern and Enflo's (2013) break point augmentation is

Methodology: The Toda Yamamoto (1995) procedure

$$
\begin{aligned}
DoG_t &= \sum_{k=0}^{n}(\varsigma_k \triangle t_{k,t} + \delta_k t_{k,t}) + \sum_{i=1}^{p} \alpha_{1,i} DoG_{t-i} + \sum_{j=p+1}^{p+m} \alpha_{2,j} DoG_{t-j} \\
&\quad + \sum_{i=1}^{p} \gamma_{1,i} PGR_{t-i} + \sum_{j=p+1}^{p+m} \gamma_{2,j} PGR_{t-j} + \varepsilon_{1,t} \\
PGR_t &= \sum_{k=0}^{n}(\varsigma_k \triangle t_{k,t} + \delta_k t_{k,t}) + \sum_{i=1}^{p} \beta_{1,i} PGR_{t-i} + \sum_{j=p+1}^{p+m} \beta_{2,j} PGR_{t-j} \\
&\quad + \sum_{i=1}^{p} \delta_{1,i} DoG_{t-i} + \sum_{j=p+1}^{p+m} \delta_{2,j} DoG_{t-j} + \varepsilon_{2,t},
\end{aligned}
\tag{1}
$$

Methodology: The Toda Yamamoto (1995) procedure

Granger non-causality test of PGR_t on DoG_t

$$H_0 : \gamma_{1,i} = 0 \quad \forall \quad i = 1, ..., p \tag{2}$$

where γ_i are the p lagged coefficients of PGR in Equation (1) . The test for non-causality of DoG_t on PGR_t is calculated similarly. The exogenous coefficients $\gamma_{2,j}$ and $\delta_{2,j}$ for $j = p + 1, ..., p + m$ are left aside.

Methodology: Johansen Cointegration Test (2001)

Procedure is called the $Hl(r)$ test in Johansen et al. (2000)

1. Step 1 to 3 as for the TY procedure.
2. Add one exogenous structural break:
   2.1 Define two variables of the form

$$i_{2,t} = \begin{cases} 1 & \text{if } t = t^* + 1 \\ 0 & \text{else} \end{cases} \quad d_{2,t} = \begin{cases} 0 & \text{if } t \leq t^* \\ 1 & \text{if } t \geq t^* \end{cases} \tag{3}$$

   where t^* denotes the break point period and $t = 1, ..., T$ for T equal to all observations.

   2.2 Specify VAR model for the Johansen testing procedure by including:
   - A linear trend c,
   - $d_{2,t-k}$, where k is designated the maximum lag length,
   - an interaction term $c \times d_{2,t-k}$ as well as
   - $i_{2,t-l}$, where $l = \{0, 1, ..., k-1\}$ with k defined as above.

   2.3 Critical values derived depending on position of breaks

EMPIRICS & RESULTS

Table: Summary of Testing Procedures, Part 1

Full Sample, ...	Unit Root Tests	Results	Further analysis
...no breaks in either series	standard ADF, PP and KPSS tests	DoG is I(2) PGR is (1)	T-Y p.
...one break in each series	ZA and PB test	DoG is I(1) PGR is I(1)○	Cointegration analysis with structural breaks and T-Y p.
...two breaks in each series	LM Test with two structural breaks	DoG is I(1) PGR is I(1)○	Cointegration analysis with structural breaks and T-Y p.

Notes: Results where no definite conclusion on the order of integration was derived are designated ● or ○ in the above table if $m = \{0, 1\}$ or $m = \{1, 2\}$ respectively.

Results

Table: Summary of Testing Procedures, Part 2

Sub-samples, ... split in 2009M07:	Unit Root Tests	Results	Further analysis
pre-crisis I	standard ADF, PP and KPSS tests	DoG is I(2) PGR is I(1)	TY p.
post-crisis I		DoG is I(1) PGR is I(2)●	TY p.
... split in 2008M03 and 2010M03			
pre-crisis II	standard ADF, PP and KPSS tests	DoG is I(1) PGR is I(0)	TY p.
post-crisis II		DoG is I(1)● PGR is I(1)●	TY p.

Notes: Results where no definite conclusion on the order of integration was derived are designated ● or ○ in the above table if $m = \{0, 1\}$ or $m = \{1, 2\}$ respectively.

Results

Table: Results of Granger-Causality Tests Following the T-Y Procedure

Full Sample, ...	DoG ⇒ PGR		PGR ⇒ DoG		Proposed value for m
...no breaks in either series	0.0218	*	0.0019	*	2
... one break in each series	0.0261	*	0.0077	*	1
... two breaks in each series	0.3415		0.1613		1
Sub-sample, ...					
... split in 2009M07					
pre-crisisI	0.0163	*	0.0802	o	2
post-crisisI	0.576		0.581		2●
... split in 2008M03 and 2010M03					
pre-crisisII	0.914		0.884		1
post-crisisII	0.544		0.872		1●

Notes: The table reports p-values of the Wald test. Arrows denote the direction of Granger-causality. The levels of significance are denoted o,+ and * for the 10%, 5% and 1% level respectively. Scenarios where the maximal order of integration was subject to uncertainty with $m = \{1, 2\}$ are denoted ●.

Results

Table: Results Cointegration Test

No. of Breaks	Hypothesized No. of CE(s)	Trace Statistic	5% Critical Value
None	None	52.359	25.872
	At most 1	5.729	12.518
One	None	38.070	35.022
	At most 1	9.163	17.684
Two	None	39.020	41.757
	At most 1	5.667	21.512

Notes: Critical values derived based on position of break point(s).

CONCLUSIO & POSSIBLE EXTENSIONS

Conclusio

Contribution: Time series perspective on austerity using monthly time series data for the UK.

Allowing for stuctural breaks and the financial crisis, no empirical evidence of a causality relation between the gross debt level and the GDP growth rate can be reported through either a Granger causality test or cointegration tests.

Results suggest: Failure to control for these interventions could result in misleading implication that fiscal discipline can assist an economic recovery.
Findings are consistent with Puente-Ajovín and Sanso-Navarro (2014) on austerity measures who find little support for this policy as a growth regenerator.

Critisism & Extensions

'Granger-causality in a bivariate system may be due to an omitted variable. It is also known that non-causality in a bivariate system may theoretically result from neglected variables.'
(Lutkepohl 1982, p. 367)

Easy to imagine that there are many possible determinants of both the growth rate and public debt that are omitted here. Why does excluding these not lead to obvious possibilities of a severe bias?

Future work will concentrate on these model extensions, e.g. interest rates, economic conditions in trading partner countries or country specific economic volatility measures.

Questions!

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