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Which gap? Alternative estimations of the potential output and the output gap in the Italian economy

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Introduction and motivation

- ✓ PO and OG determine the **cyclical position** with implications for the **fiscal surveillance** process within the scope of the Stability and Growth Pact.
- ✓ These variables are not observable, and their estimation is characterised by considerable **uncertainty**: the series used by the European Commission (EC) have diverged substantially from those produced by other international organisations (OECD and IMF), especially in recent years.
- ✓ There is considerable **variability** not only among the various approaches but also within the same method, depending on the **vintage** of the estimates.

In this work we investigate the **variability** of PO and OG estimates due to **statistical features of the model**.

Overview

- ✓ We present an estimation based on **structural time series model** that extracts the signal from output indicators (GDP, unemployment rate and capacity utilisation) and from a Phillips curve, in the vein of Jarocinski and Lenza (2016).
- ✓ We allow the model to incorporate **many specifications** that differ in the information sets and in the specification of the trend (Random Walk, Integrated-RW, Local Level Trend).
- ✓ We consider several **measures of goodness** (statistical fit, revision of the estimates and inflation-predicting capacity).

Main findings

- ✓ The empirical findings on the Italian data demonstrate that as the specification of the model changes the estimation of the **OG** and **PO** vary over a broad interval.
- ✓ Any model appears **optimal** only in relation to a **specific measure** or a **time period**, and none of them is better in absolute terms.
- ✓ The policy implications point to the need of :
 - a model that is **sufficiently flexible** to incorporate different economic conditions (such as anomalous cyclical conditions or hysteresis)
 - appropriate **measures of error** of the estimates.

Summary

- Introduction and motivation
- Related literature
- The econometric model
- Empirical results
- Assessment of alternative models
- Conclusion

Related literature

There is a huge literature on the measure of PO and OG, but there is not a unique way of estimating them as each approach presents advantages and drawbacks. Two main avenues:

- 1 Production Function method \Rightarrow International institutions - OECD: Ollivaud and Turner (2014)), EC: Havik et al. (2014).
- 2 Structural Time Series \Rightarrow Academy (Kuttner (1994), Apel and Jansson (1999), Gerlach and Smets (1999), Planas et al. (2008) Domenech and Gomez (2006), Jarocinski and Lenza (2016); IMF: Alichì et al. (2015).

The Econometric Model

$$y_t^n = \mu_t^n + b^n(L)\phi_t + \varepsilon_t^n \quad (\text{output : GDP, UR, CU}) \quad \varepsilon_t^n \sim \text{NID}(0, \sigma_{\varepsilon^n}^2)$$

$$\pi_t = \mu_t^\pi + a(L)\phi_t + \varepsilon_t^\pi \quad (\text{Phillips curve}) \quad \varepsilon_t^\pi \sim \text{NID}(0, \sigma_{\varepsilon^\pi}^2)$$

$$\phi_t = \theta_1\phi_{t-1} + \theta_2\phi_{t-2} + \kappa_t \quad (\text{cicle : OG}) \quad \kappa_t \sim \text{NID}(0, \sigma_\kappa^2)$$

$$\mu_t^n = \mu_{t-1}^n + \beta_{t-1}^n + \eta_t^n \quad (\text{trend}) \quad \eta_t^n \sim \text{NID}(0, \sigma_{\eta^n}^2)$$

GDP: $y_t = \mu_t + \phi_t$ with 3 different trends:

- RW: $\sigma_\zeta^2 = 0$ closer to observed data
- LLT: $\mu_t = \mu_{t-1} + \eta$; $\beta_t = \beta_{t-1} + \zeta$ $\zeta \sim \text{NID}(0, \sigma_\zeta^2)$ $\eta \sim \text{NID}(0, \sigma_\eta^2)$
- IRW: $\sigma_\eta^2 = 0$ smoother and flat.

Figure: Output Gap and Potential Output.

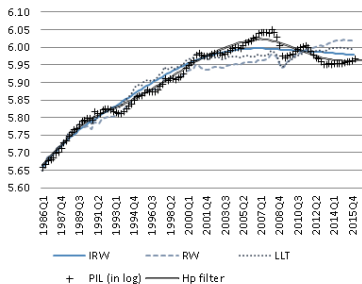
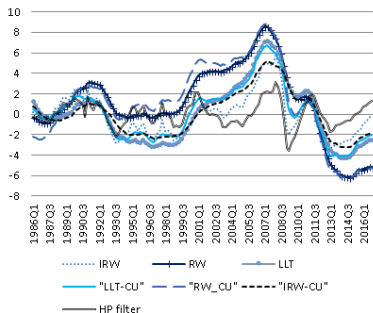


Table: Output gap in different specifications along with some benchmark estimates

	LLT	RW	IRW	LLT-CU	RW-CU	IRW-CU	Median	OECD	IMF	EC	HP
2010	2.0	1.6	0.3	0.6	0.6	1.4	1.0	-2.8	-1.3	-2.0	-0.3
2011	1.5	0.7	1.2	0.8	0.3	0.9	0.9	-2.0	-0.5	-1.3	1.5
2012	-1.9	-3.0	-1.6	-2.4	-3.4	-1.3	-2.1	-4.5	-2.8	-2.9	-0.4
2013	-3.9	-5.4	-3.1	-4.0	-5.7	-2.9	-3.9	-5.8	-4.1	-4.2	-1.3
2014	-4.2	-6.1	-2.7	-4.0	-6.2	-3.2	-4.1	-5.4	-4.1	-3.8	-0.7
2015	-3.4	-5.7	-1.8	-3.0	-5.7	-2.6	-3.2	-4.3	-3.3	-2.8	0.0
2016	-2.7	-5.2	-0.5	-2.2	-5.3	-2.0	-2.4	-3.2	-2.7	-1.7	1.0

Note: The model with CU includes the serie of capacity utilization.

Results

- All the specifications of the unobserved components model produce a **wider output gap** than the HP filter
- LLT closer to the IMF; RW more negative estimate for the recent years similar to OECD figures.
- LLT and RW wider measures of OG than EC estimate in the more recent period (PO well above actual GDP).
- A synthetic measure, the **median value** of the estimates appears to be close to the **IMF** figure.
- The series of **capacity utilization** contributes to estimate a wider OG in periods of **recession**.

Assesment of alternative models

Three different criteria are considered:

- ① Goodness of fit with observables;
- ② Stability of the estimated parameters;
- ③ Ability to identify the phase of the cycle on the basis of the capacity to predict inflation.

However, the various criteria do **not provide unequivocal answers**, leading to different functional forms.

- 1 fit to data: LLT and LLT-CU (logLik and BIC and AIC criteria).
- 2 standard error of the OG: IRW

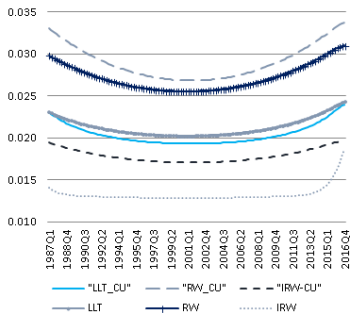


Figure: SE of OG

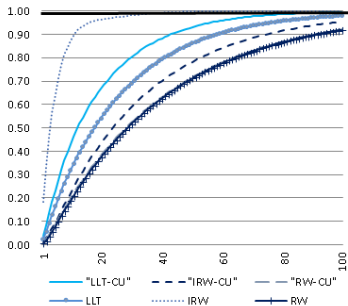


Figure: Perc. error reduction after n periods

Table: Annualized inflation forecasting error (MSE) and Diebold-Mariano test h quarters ahead (2002-2016)

	h=1		h=2		h=3		h=4		Average
LLT	0.09	*	0.24	*	0.44	**	0.64	**	0.36
RW	0.13		0.36		0.62	**	0.86	***	0.49
IRW	0.05	*	0.14	*	0.30	**	0.49	**	0.25
LLT-CU	0.12	**	0.23	**	0.37	**	0.52	**	0.31
RW-CU	0.15	***	0.28	***	0.45	***	0.65	**	0.38
IRW-CU	0.23	***	0.39	***	0.58	***	0.76	***	0.49
median	0.09		0.13		0.18		0.24		0.16
naive RW	0.04		0.10		0.15		0.21		0.13

Diebold Mariano test versus naive RW: ***signif. at 1%, ** at 5%, * at 10%.

Table: Annualized inflation forecasting error (MSE) in subperiods

		h=1	h=2	h=3	h=4	Average
LLT	2002-2007	0.05	0.18	0.37	0.62	0.31
	2008-2011	0.14	0.35	0.56	0.61	0.42
	2012-2016	0.09	0.22	0.43	0.71	0.36
RW	2002-2007	0.05	0.18	0.37	0.61	0.30
	2008-2011	0.29	0.81	1.35	1.68	1.03
	2012-2016	0.08	0.17	0.28	0.44	0.24
IRW	2002-2007	0.05	0.10	0.21	0.35	0.18
	2008-2011	0.05	0.16	0.31	0.40	0.23
	2012-2016	0.06	0.17	0.41	0.77	0.35
LLT-CU	2002-2007	0.05	0.09	0.16	0.27	0.14
	2008-2011	0.07	0.16	0.24	0.27	0.18
	2012-2016	0.27	0.48	0.76	1.08	0.65

Note: This is a selection of models that perform better.

Summary

- We estimate of the output gap for Italy, over the period 1985-2016, based on a **set of models** that uses a **multivariate filter**: the signal is extracted from output indicators (GDP, unemployment rate and capacity utilisation) and from a Phillips curve (similar to Jarocinski and Lenza (2016)).
- The selected models differ in their **information sets** and the specification of the **trend**.
- We analyse the **performance** of the different models by comparing them with estimates from international institutions and applying some measures of error.

Current work at UPB

We have a research project in collaboration with Tor Vergata University for the estimation of the Italian OG. We started by replicating the EC model (writing Matlab codes), then we modified some specifications and finally we ended up with a a multivariate model. Preliminary results show that:

- the Italian **TFP is higher** than that estimated by EC (which is negative since 2003).
- the **Phillips curve** is the more cumbersome part of the model and **inflation expectations** play a crucial role
- a multivariate model in the PF approach cast in SSF (such as Proietti, Musso, Westerman 2006) does not seems the best choice.
- **structural time series** approach (similar to this paper) presents **better results** in terms of reliability and stability of the estimates.

Thank you for attention!
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