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Mikael Apel and Per Jansson

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Some further evidence on interest-rate smoothing:

The role of measurement errors in the output gap

Mikael Apel, Per Jansson*

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Abstract

It has been suggested that interest-rate smoothing may be partly explained by an omitted variable that relates to conditions in financial markets. We propose an alternative interpretation that suggests that it relates to measurement errors in the output gap.

Keywords: Interest-rate smoothing; Measurement errors; Output gap

JEL classification: E43; E44; E52

*Sveriges Riksbank, SE-103 37 Stockholm, Sweden. Email: mikael.apel@riksbank.se; per.jansson@riksbank.se.
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1. Introduction

It is a stylised fact that the empirical fit of an estimated monetary policy reaction function improves considerably when a lagged interest rate is included. There is less agreement on how this finding should be interpreted, however. The traditional explanation is that it reflects policy inertia, i.e. that the central bank for one reason or another chooses only to gradually adjust the interest rate towards the desired level (given by the original Taylor rule).

This view has been challenged in recent years, notably by Rudebusch (2002), who argues that the large and significant coefficient on the lagged interest rate is the result of a misspecified representation of monetary policy. More specifically, he proposes that the reason why the Fed chooses to smooth interest rates is that it reacts to some serially correlated variable(s) that is incorrectly omitted from the reaction function. The significance of the lagged interest rate might therefore be spurious and should not be regarded as support for policy inertia.

The relative importance of policy inertia and omitted variables has been investigated in a number of recent studies (e.g., Castelnuovo, 2003, English et al., 2003, Gerlach-Kristen, 2004), most of which conclude that both mechanisms are at play simultaneously. However, relatively few papers have so far tried to investigate empirically what the omitted variable actually represents. A notable exception is Gerlach-Kristen (2004) (hereafter GK), who estimates the omitted variable as an unobserved component within a model that nests the two hypotheses. Since the estimated series turns out to be rather closely related to a risk premium on corporate bonds, GK concludes that interest-rate smoothing, in part, is likely to be a result of concerns for financial market conditions.

In this paper we propose an alternative, equally plausible interpretation of the omitted variable, namely as a "measurement error" in the output gap. The measurement error arises because the Fed's real-time assessment of the output gap differs from the gap that is obtained from official sources.[1]

2. Empirical analysis

We use quarterly US data on the federal funds rate (*i*), inflation (π), and the output gap (*y*) covering the time period 1987:4–2004:4. The output gap is constructed as the (log) difference between real GDP and the CBO estimate of potential GDP. All variables are from the FRED II database, Federal Reserve Bank of St Louis.

The model analysed by GK is:

$$i_t = (1-\rho)(\alpha\pi_t + \beta y_t + \gamma z_t) + \rho i_{t-1} + \eta_t\,, \tag{1}$$

$$z_t = \varphi z_{t-1} + u_t\,, \tag{2}$$

where z is an unobserved component, and η and u mutually and serially uncorrelated white noise error terms. If $\varphi = 0$, then the unobserved z variable is white noise and (1) becomes observationally equivalent to the so-called policy inertia model. If, on the other hand, $\rho = 0$ and $\sigma_\eta^2 = 0$, then the lagged interest rate does not enter (1) and we end up with the so-called unobserved variable model.[2] Of course, if none of the restrictions hold, then both models are valid and monetary policy is characterised by both inertia and concerns for the unobserved z variable.

GK estimates (1)–(2) over the period 1987:4–2003:3 using maximum likelihood and the Kalman filter (subject to the normalisation $\gamma = 1$). The first column in Table 1 re-estimates

[1]For a normative rather than positive analysis of the importance for monetary policy of measurement errors in the output gap, see Smets (2002).
[2]Without the restriction on the variance of η the policy shocks would follow an MA(1) process and thus not be white noise.

her model using our updated data. As can be seen, the estimates of ρ, φ, and the variance of η are all significant at the 1% test level, implying that both policy inertia and an omitted variable are important in explaining interest-rate smoothing. Interestingly, the estimate of ρ is lower than in the case of OLS estimation of (1) subject to $\gamma = 0$, in which case the estimate is 0.811.[3] Perhaps the most interesting finding is that the estimates of the unobservable z turn out to be rather closely related to a risk spread that measures the difference between the yields on a safe and risky bond (Fig. 1).[4] From this, GK concludes that interest-rate smoothing, in part, is likely to be a result of concerns for financial market conditions.

In this paper we propose an alternative, equally plausible interpretation of the unobservable z variable. We consider the following generalised unobserved-components (UC) model:

$$i_t = (1-\rho)(\alpha\pi_t + \beta\tilde{y}_t) + \rho i_{t-1} + \eta_t, \tag{3}$$

$$z_t = \varphi z_{t-1} + u_t, \tag{4}$$

$$y_t = \tilde{y}_t + z_t, \tag{5}$$

$$\tilde{y}_t = \gamma_1 \tilde{y}_{t-1} + \gamma_2 \tilde{y}_{t-2} + \varepsilon_t, \tag{6}$$

where we have introduced a new latent variable, $\tilde{y}$, that represents the output gap as perceived by the Fed. The idea is that the CBO output gap measures the Fed's (implicit) real-time estimate of the gap with a "measurement error", perhaps because real-time and final GDP releases are different or because the Fed's assessment of potential GDP differs from the CBO's. As can be seen, our UC model is a straightforward generalisation of model (1)–(2), obtained by imposing the restriction $\beta = -\gamma$ and adding Eq. (6). The main advantage of this

[3]The two estimates are however not significantly different. A Wald test accepts the restriction that ρ equals 0.81 in the GK model with a p value of approximately 28%.
[4]All estimates of unobservables are two-sided in this paper.

formulation is that z becomes explicitly interpretable, namely as a measurement error of the output gap estimated by the CBO.

The estimates of the UC model (3)–(6) appear in the second column of Table 1. All parameter estimates are highly significant and economically reasonable. It is interesting to note that the estimate of ρ is lower than in the GK model.[5] Also, the R^2 associated with the prediction errors of the federal funds rate is slightly higher for system (3)–(6) than for system (1)–(2) (0.824 compared to 0.809).

The evidence in Table 2 further strengthens the case for our generalised UC model. This table shows that the adjusted output gap $\tilde{y}$ has a higher (and statistically more precise) correlation with inflation than the standard CBO gap measure. Adjusting y for z thus seems to generate a measure of resource utilisation that better reflects actual capacity constraints in the economy.

Another piece of evidence may be the real-time statements made by the Fed. Of course, the Fed does not base its policy on any explicit measure of the output gap and the evidence therefore is anecdotal. Nevertheless, in periods when the two output gap estimates are qualitatively different, it may be possible to find some evidence in the minutes of the FOMC that allows us to judge whether one estimate is preferable to the other. In our sample, such a period occurs during 1994–1997, where the adjusted output gap $\tilde{y}$ is positive while the CBO gap is negative (Fig. 2). The following two quotations are from the minutes of the FOMC in 1996:

"More generally, resource utilization was expected to remain high [in 1996] and greater pressures could emerge in labor and product markets." (January 30–31, page 15.)

[5]For the UC model, the Wald test rejects the restriction that ρ equals 0.81 at the 5% test level. The p value for this test is slightly below 4%.

“Nonetheless, broad measures of price inflation […] did not exhibit any uptrend despite […] high levels of resource use.” (August 20, page 5.)

Obviously, such statements square better with an output gap that is positive rather than negative.

Finally, Fig. 3 documents the differences between the estimates of z from models (3)–(6) and (1)–(2). Evidently, the policy implications of the two estimates are occasionally quite different.

3. Conclusion

In this paper we present empirical evidence that suggests that interest-rate smoothing is due in part to measurement errors in the output gap. The measurement error arises because the Fed’s real-time assessment of the output gap differs from the gap that is obtained from official sources.

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Fig. 1. Paths of *z* and risk premium on corporate bonds in Gerlach-Kristen model. The risk spread has been normalised so that it has the same mean and variance as *z*. The variable is constructed as the difference between a ten-year US Treasury note yield and Moody's Baa corporate bond yield. Both yield series are from the FRED II database, Federal Reserve Bank of St Louis.

Fig. 2. Paths of output gaps according to CBO and UC model.

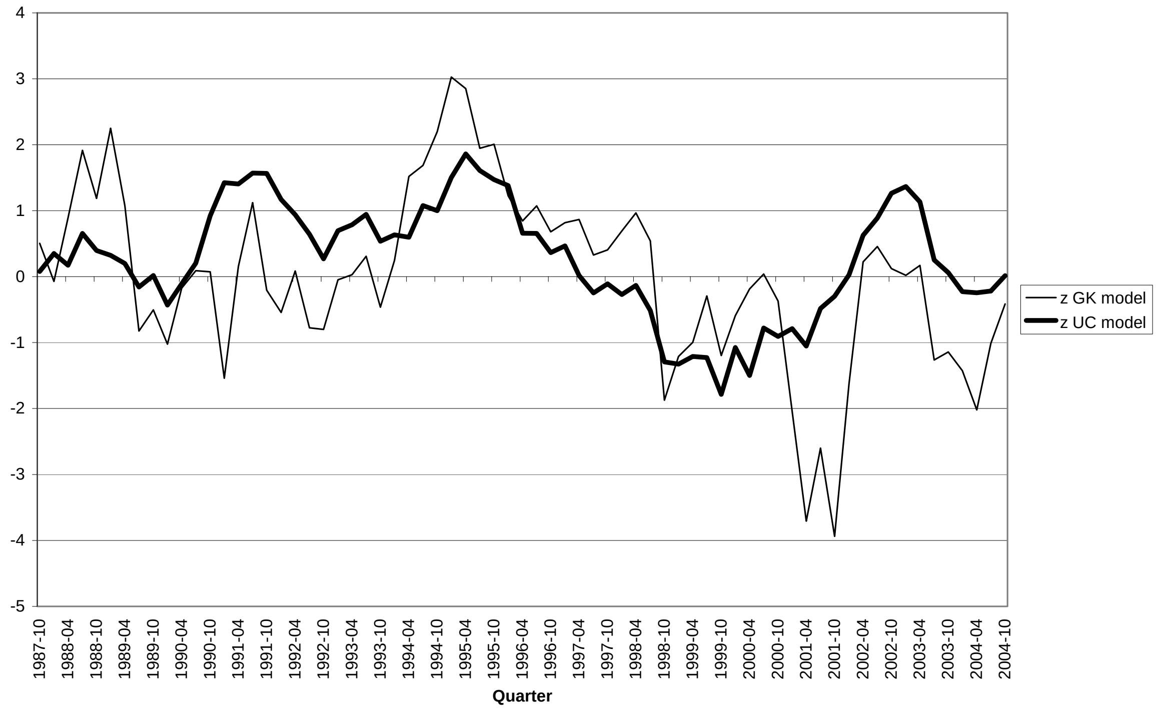

Fig. 3. Paths of *z* according to Gerlach-Kristen model and UC model. To ease comparisons the *z* variable from the UC model has been multiplied by –1.

Table 1

Estimation results

Parameter	Gerlach-Kristen model	UC model
Constant	0.4587	0.8123*
α	1.5964***	1.3285***
β	1.1204***	1.7688***
ρ	0.7220***	0.6366***
φ	0.7185***	0.8978***
γ_1	–	1.5243***
γ_2	–	–0.5878***
σ_η^2	0.0129***	0.0404***
σ_u^2	0.9091	0.1466***
σ_ε^2	–	0.0741***

* Significant at 10% level.

** Significant at 5% level.

*** Significant at 1% level.

Table 2

Correlations between output gaps and inflation

	Output gap, CBO	Output gap, UC	Inflation
Output gap, CBO	1.0000		
Output gap, UC	0.8693 (0.0000)	1.0000	
Inflation	0.2159 (0.0818)	0.2845 (0.0220)	1.0000

The output gaps are lagged four quarters. Numbers within parentheses are approximate *p* values associated with the null of two uncorrelated time series.

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Sveriges Riksbank
Visiting address: Brunkebergs torg 11
Mail address: se-103 37 Stockholm

Website: www.riksbank.se
Telephone: +46 8 787 00 00, Fax: +46 8 21 05 31
E-mail: registratorn@riksbank.se

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