Institut für Wirtschaftsforschung Halle
Halle Institute for Economic Research

Did the Crisis Affect Potential Output?

Makram El-Shagi

April 2010 No. 9

IWH-Diskussionspapiere
IWH Discussion Papers

Did the Crisis Affect Potential Output?

Makram El-Shagi

April 2010 No. 9

Author: *Makram El-Shagi*
Department of Macroeconomics
Phone: +49 345 7753 835
Email: Makram.El-Shagi@iwh-halle.de

Editor:

Halle Institute for Economic Research (IWH)
Prof Dr Dr h. c. Ulrich Blum (President), Dr Hubert Gabrisch (Head of Research)
The IWH is member of the Leibniz Association.

Address:	Kleine Märkerstraße 8, 06108 Halle (Saale)
Postal Address:	P.O. Box 11 03 61, 06017 Halle (Saale)
Phone:	+49 345 7753 60
Fax:	+49 345 7753 820
Internet:	http://www.iwh-halle.de

Did the Crisis Affect Potential Output?*

Abstract

Conventional Phillips-curve models that are used to estimate the output gap detect a substantial decline in potential output due to the present crisis. Using a multivariate state space model, we show that this result does not hold if the long run role of excess liquidity (that we estimate endogeneously) for inflation is taken into account.

Keywords: output gap, liquidity, state space models

JEL classification: E3, E4

* The author is indebted to Oliver Holtemöller, Sebastian Giesen, Henry Dannenberg and Peter Haug for valuable comments and discussions.

Hat die Krise das Produktionspotenzial reduziert?

Zusammenfassung

Übliche Phillipskurvenmodelle, die verwendet werden, um die Produktionslücke zu schätzen, deuten auf einen massiven Rückgang des Produktionspotenzials durch die gegenwärtige Krise hin. Mit Hilfe eines multivariaten Zustandsraummodells wird im vorliegenden Papier gezeigt, dass dieses Resultat nicht haltbar ist, wenn die Wirkung der (hier endogen geschätzten) Überschussliquidität auf die Inflation berücksichtigt wird.

Schlagwörter: Produktionslücke, Liquidität, Zustandsraummodelle

JEL-Klassifikation: E3, E4

1 Introduction

It is well known that most filtering techniques have problems to identify latent variables like potential GDP and the corresponding output gap at the end of sample. Traditionally, Phillips-curve based models, that exploit the short run correlation of output gap and inflation, are employed to mitigate the extreme end of sample problems of univariate decompositions of GDP into a trend component and a cycle component (Gerlach and Smets 1999). However, recent papers highlight that the real time output gap estimates are severely adjusted for several years after the initial estimate (Graff and Sturm 2009). This instability issue is dramatically augmented by the current financial crisis since outliers at the current margin are especially hard to judge. Thus, currently there is an ongoing debate about the output gap at the present margin. Phillips-curve models usually associate price stability with a closed output gap.[1] While this gives reasonable results most of the time, it is problematic in the current situation where the central banks intervened substantially to compensate deflationary pressures from the real economy by inducing counteracting inflationary pressure from the monetary domain. Since we are currently (December 2009) close to price stability, the Phillips-curve models consider most of the recent reduction of GDP as a reduction of trend GDP or potential production, i.e. they estimate a rather small output gap. Thus, the econometric departments of the big inter- and intragovernmental institutions that are presently strongly concerned with this issue (namely the IMF, the OECD and the European Commission) unambiguously argue that there are substantial losses to potential output all over the world. Contrarily, production function based models that define potential GDP through simplified production functions estimate a very high gap, since there is no reduction in the input factors. However, the production functions essentially impose very strong restrictions on the behavior of potential GDP.

We propose a multivariate state space model that accounts for the monetary pressure on inflation by including excess liquidity in the equation that describes the dynamics of inflation in addition to the commonly used Phillips-curve based specification. Excess liquidity (or money overhang) that is an unobservable component of money velocity itself is modeled following an approach of El-Shagi and Giesen (2010) who extend

[1] However, this does not necessarily imply that the production capacity is fully utilized. Contrarily to the original definition, production potential is not the production capacity in these models but rather a trend component that captures the production at the hypothetical average level of capacity utilization. Thus, the gap can be positive in these models in times of a boom.

previous works of Orphanides and Porter (2000, 2001) and others on nonlinearities in the development of equlibrium velocity. In the present paper, we include a standard Phillips-curve decomposition of GDP into the vector error correction style model of El-Shagi and Giesen to allow the simultaneous estimation of money overhang and GDP gap. That is, we combine the short run Phillips-curve dynamics of inflation with the long run restriction that is described by the quantity theory of money.

Concerning the underlying model of inflation our model is closely related to the seminal P-Star-model by Gerlach and Svensson (2003). Similar to our approach, their two pillar Phillips curve captures inflation dynamics that are simulataneously driven by the output gap, i.e. a conventional Phillips-effect, and non equilibrium velocity, i.e. money overhang. However, contrary to our approach, Gerlach and Svensson use a predetermined output gap, that is derived using the Hodrick-Prescott filter, and do not account for nonlinearities in the equilibrium velocity.

While contributing to this strand of money demand literature, by estimating a two pillar Phillips curve in an unified framework that endogeneously determines output gap, money overhang and inflation, the primary objective of the present paper is to derive a reasonable estimate of the output gap at the present margin by applying this framework. The core contribution of the present paper is that we show in a Phillips-curve framework that potential output has only suffered marginally during the crisis by accounting for the role of liquidity.

The remainder of the paper is structured as follows. The next section briefly describes the data we use. Section 3 outlines our multivariate state space model. Section 4 presents our key findings and section 5 briefly concludes.

2 Data

We analyze quarterly data from the United States economy. Our sample covers the period from 1959Q1 until 2009Q3. Our model includes CPI as price indicator, M2 as monetary aggregate and GDP as indicator for production. The individual series have been tested to be difference stationary, at least at a ten percent significance level.[2]

[2] Stationarity was tested using augmented Dickey-Fuller, Phillips-Perron, and KPSS tests.

3 The Model

The model we propose combines the long run restriction on inflation that is given by the quantity theory with short run dynamics that might be driven by a Phillips-Curve like behavior.

Following the literature, we assume that the money overhang or excess liquidity that drives the return of inflation to its long run quantity theoretical equilibrium is the inverse transitory component of velocity (i.e. the negative in the log form that we employ). The latter is derived endogenous in our model.

Instead of decomposing raw velocity into its persistent and cyclical component, we use a business cycle neutral adjusted velocity that we define:

$$v_t^{BCN} = -(m_t - p_t - y_t^*), \tag{1}$$

where m_t, p_t, y_t and v_t^{BCN}[3] are the natural logarithms of money, prices, GDP and business cycle neutral velocity. y_t^* is trend GDP (or potential output) that is determined endogenously in the econometric model we use. Replacing velocity by business cycle neutral velocity to represent the long run relationship between money and prices, is well in line with the standard economic reasoning behind the quantity theory, i.e. that excess liquidity turns into higher prices since production cannot easily be adjusted to the higher demand resulting from abundant money supply.

Including the underlying AR process of inflation our key equation describing inflation thus takes the form:

$$\Delta p_t = \alpha + \beta(L)\Delta p_t + \gamma(L)\Delta m_t + \rho\tilde{y}_t + \phi\tilde{v}_t + \varepsilon_t, \tag{2}$$

where $\tilde{v}$ and $\tilde{y}$ are the transitory (i.e. cyclical) components of velocity and GDP. α, β, γ, ρ and phi are the regression coefficients.

Applying the corresponding adjustments to the equations that explain money growth and GDP growth we get our full state space model that consist of the signal equations:

[3] Although we do not model the income elasticity of money demand explicitly, the above definition of (business cycle neutral) velocity does not imply a restriction an income elasticity of money demand equal to 1, since all persistent components of velocity are removed independent of their origin. This data driven approach allows a parsimonious specification that is essential to derive meaningful results using a Kalman-Filter.

$$\begin{bmatrix} \Delta p \\ \Delta m \\ \Delta y \end{bmatrix}_t = A_1 * \tilde{v}_{t-1} + A_2(L) * \tilde{y}_{t-1} + A_3(L) \begin{bmatrix} \Delta p \\ \Delta m \end{bmatrix}_t + u_t, \tag{3}$$

$$m_t - p_t = -(\tilde{v}_t + v_t^*) + y_t^*$$

$$y_t = \tilde{y}_t + y_t^*$$

and the state equations:

$$v_t^* = v_{t-1}^* + \alpha_1 + \varepsilon_{1t}$$

$$\tilde{v}_t = \phi_1(L) * \tilde{v}_t + \varepsilon_{2t}$$

$$y_t^* = y_{t-1}^* + \alpha_2 + \varepsilon_{3t}$$

$$\tilde{y}_t = \phi_2(L) * \tilde{y}_t + \varepsilon_{4t}$$

Analogue to potential output y_t^*, v_t^* is the trend or persistent component of velocity. A_1, A_2 and A_3 are the coefficient matrices.

Simply replacing business cycle neutral velocity by velocity

$$v_t = -(m_t - p_t - y_t) \tag{4}$$

shows that this setup is quite closely related to vector error correction framework with known cointegration vector and a trend in the long run relation. Besides replacing GDP growth that would be used to explain inflation in a standard cointegration approach by the output gap, the key difference to the conventional cointegration framework is the endogenous estimation of the trend component (of velocity) as random walk with drift instead of using a linear trend.

Both, the cyclical component of velocity $\tilde{v}$ and the cyclical component of GDP $\tilde{y}$ are $I(0)$ by construction. The model is estimated using a Kalman-smoother.

4 Results

The coefficient estimates match conventional empirical evidence. Inflation is driven by a strong first order autoregressive process, a Phillips-curve effect (i.e. lagged output gap) and monetary overhang. Money growth follows an AR(3) process as well, and is furthermore negatively correlated with the lagged output gap and money overhang. That is, the central bank unsurprisingly reduces money supply, if there is excess liquidity and if there is a strong boom that is endangering price stability.

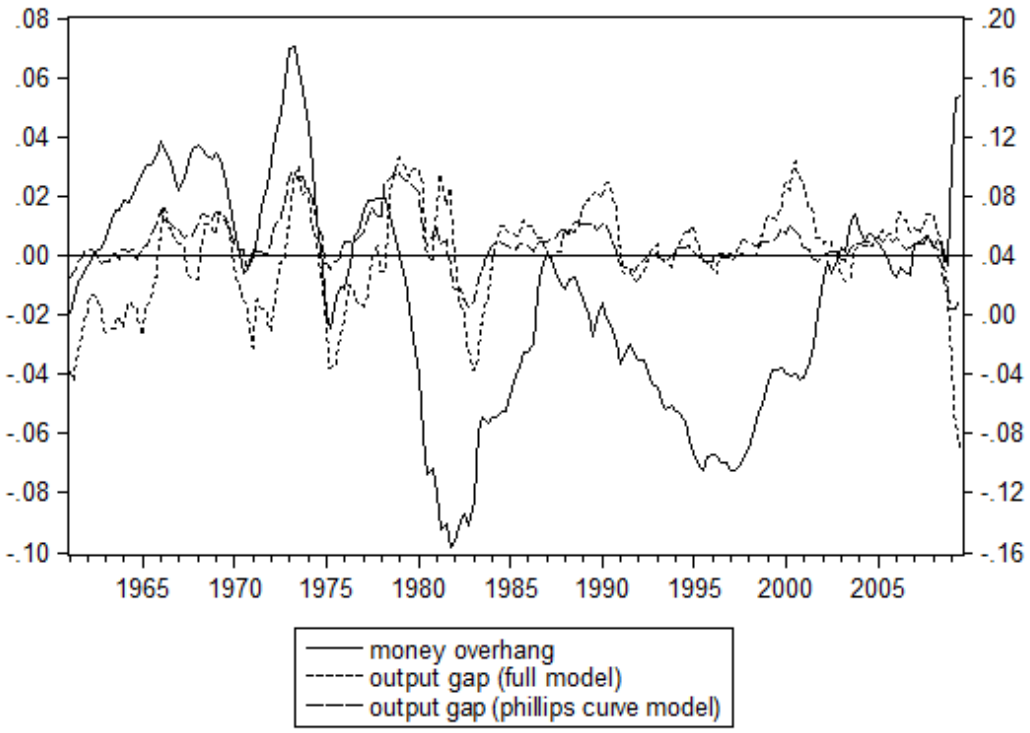
	Dependent variable:		
	Δm_t	Δp_t	Δy_t
$-\tilde{v}_{t-1}$	-0.02056806**	0.01764412***	-0.0103697
$\tilde{y}_{t-1}$	-0.27723985***	0.17113071***	0.17782849**
$\tilde{y}_{t-2}$	0.24284345*	-0.15213355*	-0.25643191**
$\tilde{y}_{t-3}$	0.06062828	0.03280435	-0.1226277
$\tilde{y}_{t-4}$	-0.16721665*	0.00611396	-0.04817876
Δm_{t-1}	0.68050923***	-0.02186948	0.0792235
Δm_{t-2}	-0.20052438*	0.03689519	0.11389352
Δm_{t-3}	0.27779936**	-0.02764786	-0.03851947
Δm_{t-4}	-0.11626703	0.0446588	-0.01925589
Δp_{t-1}	0.01568334	0.42403476***	0.21844213
Δp_{t-2}	0.16244109	0.07063176	0.06746984
Δp_{t-3}	-0.11814391	0.33241924***	0.02004472
Δp_{t-4}	-0.05692867***	0.06394985	-0.44484435
c	0.00291411*	0.00068876	0.00873783***

* = significant at 10%-level
** = significant at 5%-level
*** = significant at 1%-level

Table 1: Estimation results

Growth is mostly driven by the return of GDP to its long term potential. Neither lagged inflation, nor lagged money growth or liquidity are significantly correlated with growth. The results are summarized in table 1.

However, although we merely add one variable to the equation that is used to describe inflation in Phillips-curve based approach that estimates an output gap of roughly minus two percent at the end of sample, our results differ strongly. Despite being close to price stability, our model identifies a huge output gap of about minus 6 percent (see figure 1). However, the corresponding deflationary pressure that is



Note: The left hand scale refers to the output gap, the right hand scale to money overhang.

Figure 1: Output gap and money overhang

visible in the model, is fully compensated by a historically unique money overhang due to the recent monetary policy of the federal reserve.

This is in line with the conventional theoretical view, that potential GDP can barely collapse and that a strong drop in GDP thus usually widens the output gap almost equally strong, that is also found in the production function based output gap estimates.

All our findings are robust to replacing business cycle neutral velocity with velocity itself. The only notable difference is, that excess liquidity (i.e. the transitory component of velocity) is estimated even higher, since the current output gap is considered to be a part of transitory velocity by construction in this simplified setup.

5 Conclusion

The finding, that the crisis mostly opened the output gap and did not reduce potential GDP (as suggested by other models) is quite important for the future development of GDP. Since GDP is mostly driven by the return to potential GDP, there is hope, that we will soon face a strong growth until the old trend is reached again.

References

El-Shagi, M. and S. Giesen (2010): When does Money Become Inflation?: *IWH Discussion Paper 2/2010*.

Gerlach, S. and F. Smets (1999): Output Gap and Monetary Policy in the EMU Area. *European Economic Review* 43.4-6, pp. 801 –812.

Gerlach, S. and L. E. O. Svensson (2003): Money and Inflation in the Euro Area: A Case for Monetary Indicators?: *Journal of Monetary Economics* 50.8, pp. 1649–1672.

Graff, M. and J.-E. Sturm (2009): "The output gap revisited. Do BTS data on capacity utilisation improve output gap estimates in real time?" Working Paper.

Orphanides, A. and R. Porter (2000): P* Revisited: Money-Based Inflation Forecasts with a Changing Equilibrium Velocity. *Journal of Economics and Business* 52.1-2, pp. 87–100.

Orphanides, A. and R. Porter (2001): "Money and Inflation: The Role of Information Regarding the Determinants of M2 Behaviour." Monetary Analysis: Tools and Applications. Ed. by H.-J. Klöckers and C. Willeke. ECB.