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Updating the euro area Phillips curve: the slope has increased

Updating the euro area Phillips curve: the slope has increased[1]

Sami Oinonen[2] and Maritta Paloviita[3]

Abstract

This paper examines recent changes in the cyclicality of euro area inflation. We estimate time-varying parameters for the hybrid New Keynesian Phillips curve using three alternative proxies for the output gap. Our analysis, which is based on the state-space method with Kalman filtering techniques, suggests that the slope of the euro area Phillips curve has become steeper since 2012. Thus, the current low level of inflation and persistently negative output gap increase the risk that euro area inflation will stay below the monetary policy target for an extended period.

Keywords: Inflation, Phillips curve, Cycle

JEL: E31, E52, E32

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1 Introduction

In recent years euro area price developments have been full of surprises. In the middle of the financial crisis the decrease in the HICP inflation rate was only temporary, in spite of sharply decreasing output. On the other hand, we have had only weak economic growth and lower-than-expected inflation in the current year. In order to assess future price developments in the euro area, we need to examine how effectively the negative output gap restrains inflation. The cyclical sensitivity of inflation can be analysed using the Phillips curve.

In this paper, we estimate time-varying parameters for the euro area hybrid New Keynesian Phillips curve using the state-space method with Kalman filtering techniques. Our analysis, which is based on three different proxies for the output gap, indicates that the slope of the euro area Phillips curve has increased since 2012. This change raises the risk that the HICP inflation rate will stay below the monetary policy target for an extended period. In Sections 2 and 3 the Phillips curve and our empirical analysis are reported. Conclusions are drawn in Section 4.

2 The hybrid New Keynesian Phillips curve

The hybrid New Keynesian Phillips curve is based on the assumption that price setting is staggered (see Clarida et al. 1999). It is assumed that when setting prices, some firms are forward-looking and optimize while the rest of them behave according to backward-looking rules of thumb (Galí and Gertler, 1999) or indexation (Christiano et al. 2005). The Phillips curve parameters depend on the underlying economic structures, i.e. price rigidities and flexibility in the product and labour markets.[4] We analyse the hybrid model in the following form:

$$\pi_t = \alpha E_t^* \{\pi_{t+1}\} + (1-\alpha)\pi_{t-1} + \lambda gap_t + \theta\Delta oil_t + \varepsilon_t, \tag{1}$$

where π_t denotes the inflation rate and gap_t the output gap in period t. The parameters α and $1-\alpha$ give to the relative weights of forward-looking and backward-looking price setters.

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[4] See Woodford (2003) for the theory of the New Keynesian Phillips Curve and Mavroeidis et al. (2014) for an extensive survey of the New Keynesian Phillips curve literature.

Survey expectations in period t are denoted as E_t^*. The term Δoil_t refers to the change in oil price and ε_t is an independently and identically distributed error term.

3 Empirical analysis

We use quarterly data for the period 1990Q1-2014Q2 and measure inflation by the year-on-year percentage change in the Harmonised Index of Consumer Prices (HICP). Inflation expectations are constructed using Consensus Economics survey data.[5] We estimate the hybrid model using three different proxies for the output gap: Hodrick-Prescott filtered output gap and OECD and IMF estimates, based on the production function method. Oil price change is measured by the annual percentage change in the spot price of Brent crude oil in euros.[6]
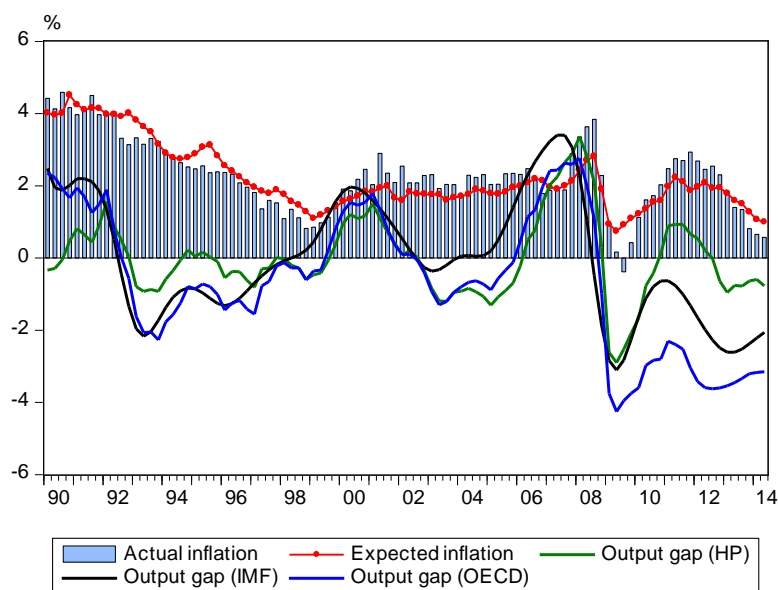

Figure 1. Euro area actual inflation, inflation expectations and alternative output gaps.

Euro area price developments have been quite volatile since 2007 (see figure 1). The HICP inflation rate peaked at nearly 4 percent but declined sharply after the Lehman Brothers

collapse due to dramatically decreasing output and falling energy prices. We had gradually accelerating inflation after mid-2009, but from 2012 onward inflation has been slowing continually. Inflation expectations also came down temporarily in the middle of the crisis, and they have been decreasing again since 2010. Since the beginning of the financial crisis the pronounced economic uncertainty has contributed to substantial differences in the alternative output gap proxies. According to the OECD and IMF estimates, the euro area output gap has been permanently negative since the onset of the crisis, whereas the HP-filtered output gap was temporarily positive in 2011-2012. Toward the end of the sample the output gap estimates are still very different, varying between -0.8% (HP) and -3.2% (OECD).

We estimate time-varying coefficients for the hybrid New Keynesian Phillips curve using the state-space method with Kalman filtering techniques. Compared to rolling regressions, this method has several advantages, since it uses available information more efficiently and obviates the need to choose an estimation window. Using this approach, model parameters can be updated optimally for every period, which is important because it allows for all Phillips curve parameters to change simultaneously in response to new information and structural changes in the economy.[7]

The estimated time-varying coefficients and corresponding conditional two-standard-deviation upper and lower confidence bands are reported in figure 2. In the 1st column the results are based on the HP-filtered output gap and in the next two columns the IMF and OECD estimates are used. Figure 2 reveals that in the pre-crisis period the forward looking-ness of the euro area inflation process gradually strengthened over time. However, since the onset of the crisis the relative weight of the forward-looking inflation component has decreased somewhat. The role of energy prices in euro area inflation dynamics was minor until 2000, but has increased to some extend thereafter.

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[7] In the state space model, all parameters are allowed maximum flexibility. They are assumed to follow random walks, and errors are assumed to be uncorrelated and normally distributed. In order to enable convergence, we set initial values for estimated parameters and define the variances of the signal equation and the state equations. As a robustness check we run our estimations under several different assumptions as to error term variances and initial values. The chosen variances affect the volatility of the parameters, but do not substantially affect the observed trends of parameters over time. As starting values for iterations we use the pre-crisis coefficients of the fixed-coefficient hybrid Phillips curve. We define the pre-c6risis period to end at 2008Q2, just before the collapse of the investment bank Lehman Brothers.

The evolution of the estimated output gap parameter measures changes in the cyclical sensitivity of euro area inflation. In all cases the slope parameter indicates that the euro area Phillips curve flattened gradually until about 2005. This may be due to increasing monetary policy credibility and globalisation, which restrained import price rises and tightened competition in the goods and labour markets. In the post 2005 period, the steepening of the slope of the Phillips curve continues until the crisis.
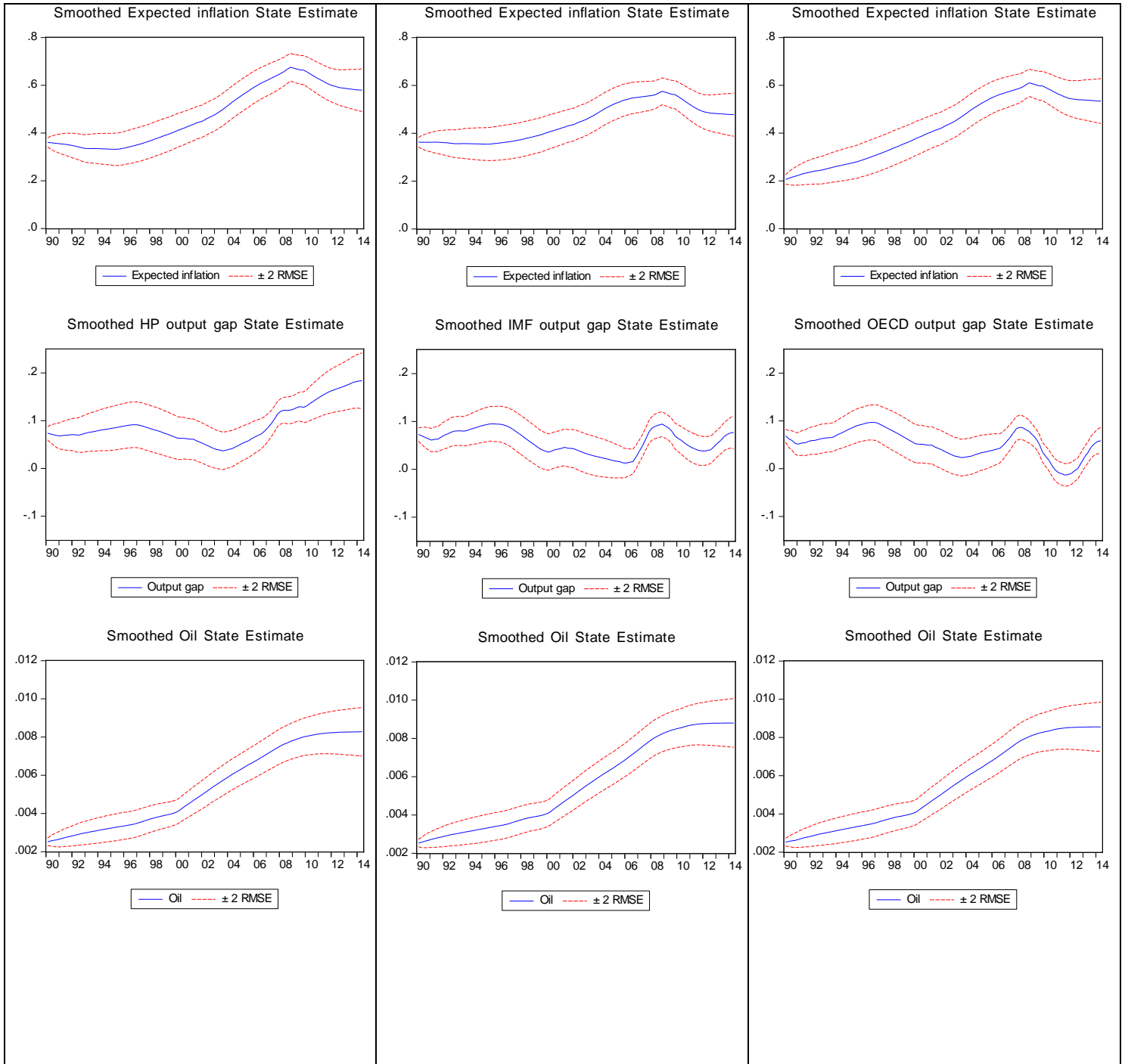

Figure 2. The estimated time-varying coefficients and corresponding conditional two-standard-deviation bands

The crisis seems to have had a definite impact on the output gap coefficient. If the cyclical demand pressure is proxied by the HP-filtered output gap, the estimated slope parameter suggests that the euro area Phillips curve has steepened steadily since the Lehman Brothers collapse. If instead we use the production function -based proxies for the output gap, our results indicate that the euro area Phillips curve first became flatter until the end of 2011 but has since been increasing quite sharply. All in all, although the alternative output gaps are very different, they all indicate that the cyclical sensitivity of euro area inflation has increased since 2012.[8]

Our estimation results are in line with recent studies by Riggi and Venditti (2014) and Larkin (2014). Riggi and Venditti (2014) analyse euro area inflation dynamics in 1999Q1-2014Q2 by considering nine different measures of inflation and fourteen measures of economic slack. Their parameter instability tests and backward-looking Phillips curve estimations indicate that the euro area Phillips curve relationship has been quite unstable in recent years. According to their analysis the cyclical sensitivity of inflation increased substantially in 2013. Riggi and Venditti (2014) argue that this can be explained by changes in goods-sector prices. Their interpretation is that the steepened Phillips curve in the euro area is due to less nominal rigidity or fewer strategic complementarities in price setting due to a reduction in the number of firms in recent years.

Larkin (2014) estimates a traditional Phillips curve based on adaptive expectations and an HP-filtered output gap for the euro area and eleven euro area countries. According to his rolling regressions the euro area Phillips curve flattened until 2007, but thereafter the slope has increased substantially. Larkin (2014) shows that the same change has been experienced in individual euro area countries with only a very few exceptions. Evidence of the steepened Phillips curve in individual euro area countries has also been presented in Banca D'Italia (2014) for Italy, Àlvarez and Urtasun (2013) for Spain and Riggi and Venditti (2014) for Italy, Spain and France.

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[8] Comparison shows that in all cases the time-varying slope parameters toward the end of the sample are smaller than the corresponding fixed coefficients estimated for the whole sample.

4 Conclusions

We investigated how the cyclical sensitivity of euro area inflation has varied over time. On the basis of three different output gap proxies and time-varying parameters for the hybrid New Keynesian Phillips curve, we provided evidence that the slope of the euro area Phillips curve has increased since 2012. This change partly explains the recently measured lowering of HICP inflation rates.

The euro area Phillips curve has become steeper, indicating that the impact of the output gap on inflation has become stronger. However, it should be emphasised that expectations are the most crucial element in euro area inflation dynamics. In the 1990s and 2000s, increasing monetary policy credibility and firmly anchored inflation expectations contributed to a decrease in the slope of the Phillips curve. Therefore, in the wake of the recovery, any deviation of inflation expectations from the monetary policy target could further increase the cyclical sensitivity of euro area inflation.

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