A Survey on Monetary Policy and Potential Output Uncertainty

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This study provides a survey of recent theoretical and empirical works analyzing the implications of imperfect information about potential output for the conduct of monetary policy. Using small-scale New Keynesian models, most of these studies conclude that, under optimal monetary policy, output gap uncertainty leads to persistent deviations between the actual and the perceived output gap in response to supply and cost-push shocks. As a consequence, the monetary policy stance turns out to be systematically looser than under perfect information in periods of large reductions in potential output, and overly restrictive relative to this benchmark in periods of large expansions in potential output. Although these previous studies shed light on the economic mechanisms by which the imprecise measurement of potential output may affect the policy behavior and thus, the dynamics of inflation, their quantitative findings depend on the assumptions about the information set available to the policymaker. In this respect, a useful role for unit labor costs emerges. This indicator provides information about potential output, and it strongly improves the central bank's ability to make stabilization policy more effective.

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In most macromodels that are currently employed for policy analysis, the deviation of actual output from its potential level plays an important role for the implementation of stabilization policies. If potential output measures the economy's capacity to produce goods and services without adding to inflationary pressures, the goal of a stabilization policy should be to keep the economy operating as close to potential as possible. Because potential output is not observable in real time, central banks devote considerable resources to estimating and continually updating their measure of potential output.

In recent years, several authors have highlighted that the imprecise measurement of potential output may have important implications for the conduct of monetary policy. Orphanides (2001, 2003b) claims that the high inflation of the 1970s (the so-called Great Inflation) reflected unavoidable policy mistakes owing to a significant misperception of the state of the economy arising under imperfect information. He argues that the large productivity slowdown at that time was interpreted for some periods by the Federal Reserve as a negative output gap. This led to an expansionary monetary policy, which aggravated the inflationary impact of potential output decrease. Eventually and after a long delay, the monetary authority realized that potential output growth was lower and adjusted policy to bring inflation down. As a result, the imperfect information about the state of the economy played the critical role in the inflation process.

Cukierman and Lippi (2005) provide analytical foundations for this mechanism within a stylized backward-looking model in which agents do not observe potential output directly. Because of the information problem, the central bank cannot perfectly distinguish between fluctuations in inflation and output that are due to shocks in potential output and those that are due to higher-frequency demand and cost shocks. The authors identify the conditions under which imperfect in-

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formation about potential output leads monetary policy to be systematically looser than under perfect information in periods of large reductions in potential output, and to be overly restrictive relative to this benchmark in periods of large expansions in potential output. The intuitive reason is that, even when they filter available information in an optimal manner, policymakers as well as the public at large detect changes in potential output only gradually. When there is a large decrease in potential output, as was the case in the 1970s, policymakers interpret part of this reduction as a negative output gap due to insufficient demand, and loosen monetary policy too much in comparison to a benchmark of full information. Thus, in periods of large decreases in potential output, inflation accelerates partly because of the relatively expansionary monetary policy stance.

Using a small DSGE (Dynamic Stochastic General Equilibrium) model calibrated to fit annual euro area data, Ehrmann and Smets (2003) show that the welfare loss due to incomplete information about potential output is substantial and mainly results from a significant increase in the variability of the output gap. Even if the central bank continuously updates its estimate of potential output, ex post the error in forecasting the output gap is large and very persistent, in particular in response to a shock to potential output.

Although these previous studies shed light on the economic mechanisms by which the imprecise measurement of potential output might affect policy behavior and thus the dynamics of inflation, they have been conducted mainly by means of calibrations (Ehrmann and Smets, 2003; Cukierman and Lippi, 2005). This approach turns out to be not exhaustive, since quantitative findings depend on the particular set of calibrated parameter values. For instance, the size and persistence of the errors in forecasting potential output and therefore the extent to which policy deviates from the ideal full information benchmark depend on the relative variance of potential output and cost-push shocks. Common welfare measures such as the central bank's expected loss and its ability to control inflation, the output gap and interest rate adjustments also depend on the covariance matrix of the shocks as well as weights attached to the central bank's objective function.

Delle Chiaie (2007) studies the robustness of these previous results concerning the monetary policy consequences of the imprecise measurement of potential output by estimating the Ehrmann and Smets (2003) model with Bayesian methods.

Her findings illustrate that the quantitative implications of potential output uncertainty crucially hinge on the information set available to the policymaker. When the information set available to the agents only includes noisy measures of output and inflation, her work corroborates the conclusion by Ehrmann and Smets (2003) that following a potential output shock, the central bank makes a large and persistent error in forecasting the output gap. This error leads the optimal policy to deviate from the benchmark value of full information, creating an effect on inflation which is completely absent in the case of perfect information. However, when monetary policy makes use of the real unit labor cost indicator, potential output uncertainty turns out to have quantitatively negligible consequences on inflation dynamics and on policymakers' welfare.

The results of her study are in line with the findings of Lippi and Neri

(2007) for the euro area. Using a small DSGE model estimated through likelihood-based methods and under the assumption of imperfect information, the authors analyze the information role of the unit labor cost and monetary aggregates. Their results show that unit labor cost contains useful information on potential output that helps to stabilize the output gap target.

The study proceeds as follow. Section 1 reviews the empirical findings in Delle Chiaie (2007). Section 2 concludes.

1 On the Role of Real Unit Labor Costs

Delle Chiaie (2007) studies the implications of incomplete information about potential output for the conduct of monetary policy using a simple backward/forward looking model as in Ehrmann and Smets (2003). The model features three shocks: a shock to potential output, a cost-push shock and a demand shock. She first estimates the model using Bayesian techniques and then uses estimates of the structural parameters and of the monetary authority's objectives to systematically compare outcomes of three different cases.

The first case is one with complete information (CI), which implies that all agents in the economy observe potential output and can therefore perfectly derive the nature of the shocks that hit the economy. In the second case, the central bank and the private sector are subject to incomplete information (II) about potential output. This implies that agents do not observe potential output directly and have to infer the state of the economy on the basis of three noisy indicators: output, inflation and real unit labor cost. Finally, in the third case, agents are still subject to incomplete information about potential output, but the real unit labor cost indicator is removed from the vector of observables.

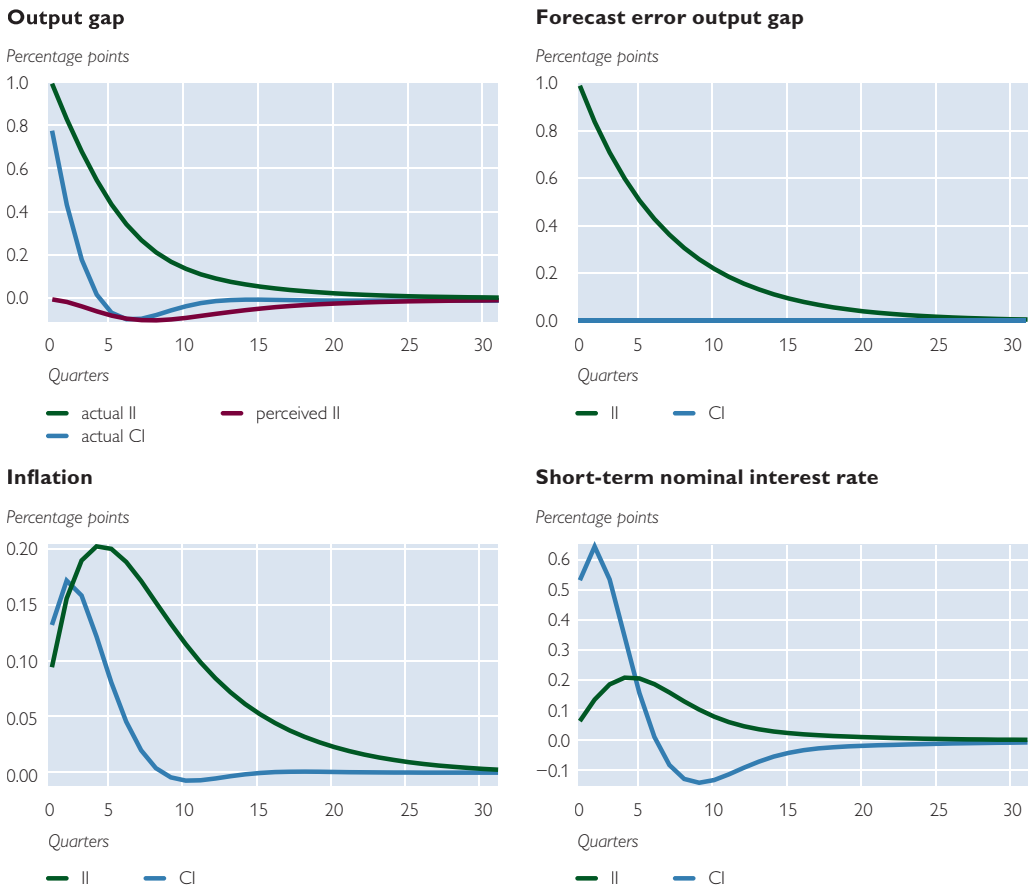
Starting with the case in which the real unit labor cost indicator is not available, chart 1 presents the responses of the actual and perceived output gap, the output gap forecast error, inflation and the nominal interest rate following a unitary decrease in potential output. Two main results emerge. First, the error in forecasting the output gap is large and persistent. For about seven quarters, the central bank estimates the output gap as negative while it is actually positive. The origins of such error stem from the fact that the central bank just observes price rises and falls in output but, under imperfect information, does not perfectly recognize whether those effects are caused by a negative potential output shock or a positive cost-push shock (or by a combination of both). As a result, the central bank is forced to assign some probability to the fact that this is actually a positive cost-push shock, which causes it to overpredict potential output. Second, the forecast error causes the optimal interest rate to deviate from the benchmark value under perfect information, leading to a persistent rise in inflation (about 15 quarters) rather than the temporary effect under complete information.

The impulse responses of chart 2 analyze the responses of the variables of interest following a positive cost-push shock.[2] As a consequence of the signal extraction problem, the central bank assigns some probability to a negative potential output shock hitting the economy, causing an underprediction of

[2] *A cost-push shock could be defined as a shock which captures anything else that might affect expected marginal costs.*

Chart 1

Negative Shock to Potential Output (Real Unit Labor Costs Are not Available)



Source: Delle Chiaie (2007).

Note: II = incomplete infomation, CI = complete information.

potential output. Chart 2 shows that following a unitary innovation in the cost-push shock, the central bank overestimates the output gap for about seven quarters. However, since the magnitude of the forecast error is smaller than in the case of a potential output shock, the inflation rate does not diverge substantially from its benchmark of full information.[3]

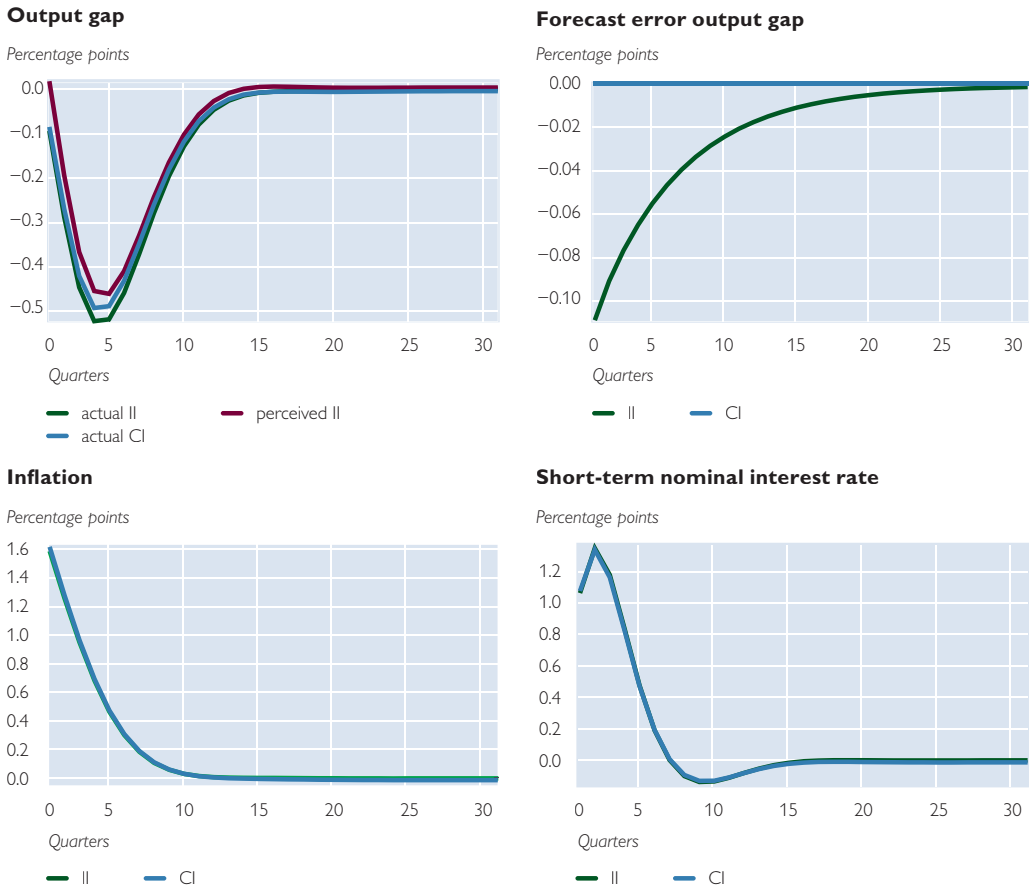
Charts 3 and 4 illustrate the responses of the variables of interest when the central bank can infer the level of potential output based on output, inflation as well as real unit labor cost. The key results of these two charts are that, in both cases, when the real unit labor cost indicator is available to agents, the errors in forecasting the output gap are quantitatively negligible. As a consequence, the optimal monetary policy rule as well as the inflation dynamics completely overlap their benchmarks of complete information.

The finding that the forecast error is very small when real unit labor cost

[3] *Following a cost-push shock, the error in forecasting the output gap is smaller because this shock is estimated to be more volatile than the potential output shock.*

Chart 2

Positive Cost-Push Shock (Real Unit Labor Costs Are not Available)



Source: Delle Chiaie (2007).

Note: II = incomplete information, CI = complete information.

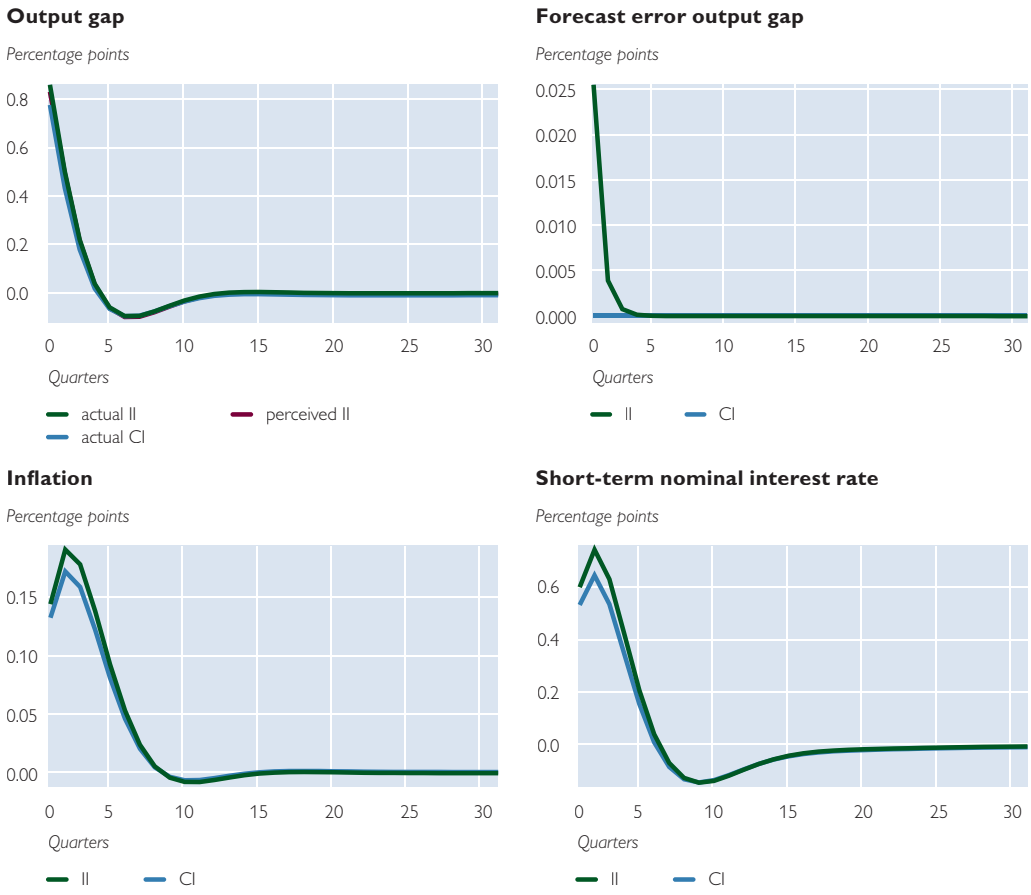
is employed in estimating the output gap suggests that this indicator contains useful information on potential output. At the same time, this result confirms the objection raised by Galí and Gertler (1999) and Galí et al. (2005) about using detrended GDP (the deviations of log GDP from a smooth trend) as a proxy for the output gap in empirical applications.[4]

Chart 5 presents an informal assessment of this point based on the patterns of cross-correlations between two alternative output gap estimates and ac-

[4] *The useful role played by the real unit labor cost indicator comes from the fact that it is a better proxy of real marginal cost. In a New Keynesian framework, prices are set as a markup over a weighted average of current and expected future nominal marginal costs. This implies that according to the theory, an important determinant of short-run inflation is given by movements in real marginal cost. As a consequence, this is a theoretically appropriate measure of real sector inflationary pressures, as opposed to cyclical measures used in the traditional Phillips curve analysis, such as detrended GDP or unemployment. This result is well known in the New Keynesian literature (Galí and Gertler, 1999; Galí et al., 2005; Sbordone, 2002) even though it has been discarded so far in the literature analyzing the effects of potential output uncertainty on monetary policy.*

Chart 3

Negative Shock to Potential Output (Real Unit Labor Costs Are Available)



Source: Delle Chiaie (2007).

Note: II = incomplete infomation, CI = complete information.

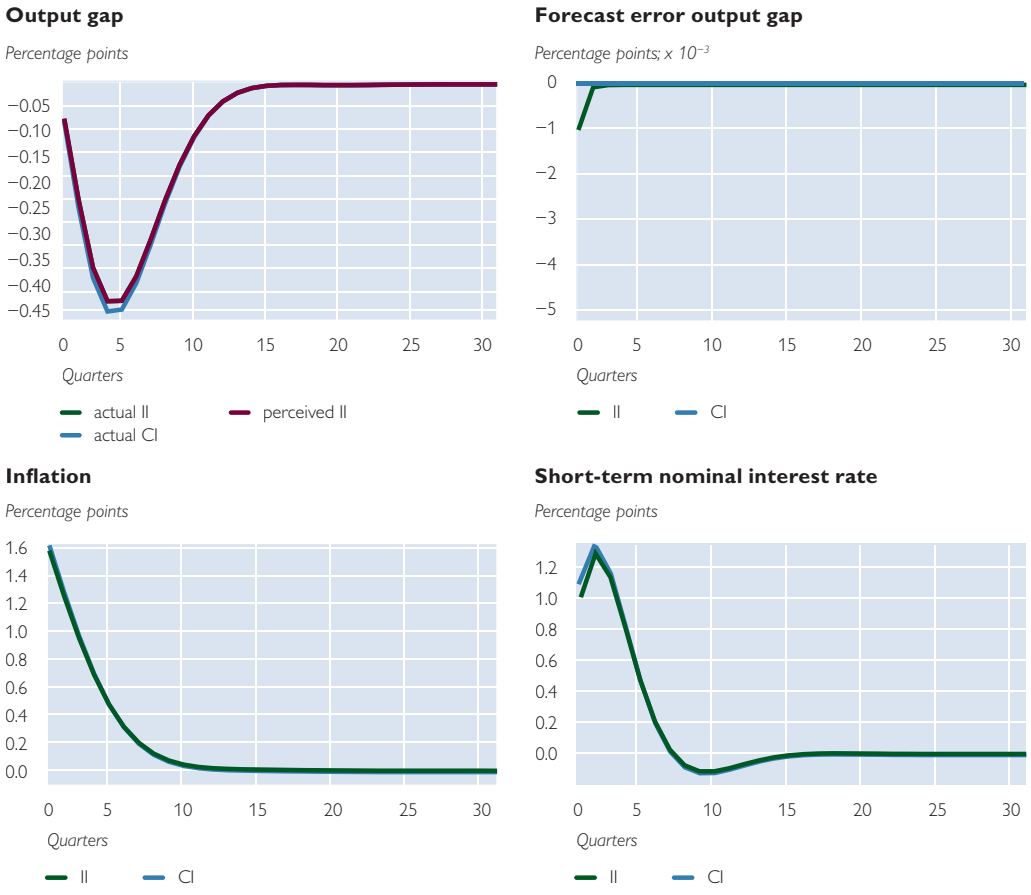
tual inflation. One output gap estimate is based on detrended GDP and real unit labor cost (green line) while the other, counterfactual estimate is obtained by removing the unit labor cost indicator from the central bank's vector of observables (orange line). A comparison of these two alternative measures of the output gap with actual inflation (blue line) clearly indicates that the output gap series estimated using real unit labor cost presents a higher correlation with actual inflation even though both are positive and statistically significant (0.60 and 0.42, respectively).

Finally, Delle Chiaie (2007) studies the usefulness of the unit labor cost indicator through the effects it produces on some welfare measures.

She analyzes how economic performance is affected by the removal of this indicator from the vector of observables. Table 1 reports the standard deviation of target variables (output gap, inflation and interest rate changes) and the central bank's expected loss. The second column considers the case in which all indicators are available to the central bank; the third one shows the values of the standard deviations in the

Chart 4

Positive Cost-Push Shock (Real Unit Labor Costs Are Available)



Source: Delle Chiaie (2007).

Note: II = incomplete infomation, CI = complete information.

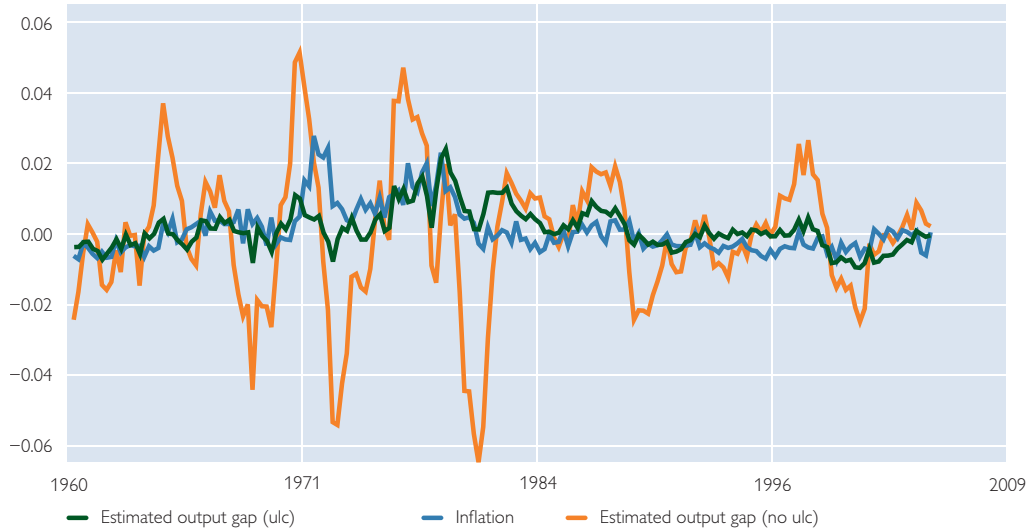
case in which unit labor costs are eliminated from the central bank's information set.

This exercise shows that expected losses increase significantly when unit labor cost is removed from the vector of observables. This effect is mainly due to the increase in the standard deviation of the output gap. The volatility of interest rate changes, however, declines marginally. This last result could be due to the fact that when unit labor costs are eliminated from the information set, the greater uncertainty about the estimate of potential output causes a reduction in monetary policy activism.

Chart 5

Actual Inflation and Two Output Gap Estimates

Percentage points



Source: Delle Chiaie (2007).

Note: ulc = unit labor costs.

Table 1

Effects of Observing Unit Labor Costs

	All indicators	No unit labor costs
Standard deviation		
Output gap	1.16	1.31
Inflation	1.37	1.37
Interest rate changes	1.03	1.00
% increase in expected losses	×	6.76

Source: Delle Chiaie (2007).

2 Conclusions

In recent years, the implications of imperfect information about potential output for the conduct of monetary policy have been studied more formally in quantitative models of optimal monetary policy. These works have argued that when the policymaker is uncertain about the extent to which fluctuations in output and inflation are due to changes in potential output or to cyclical demand and cost-push shocks, the central bank can make large and persistent mistakes in estimating potential output.

Although these previous studies shed light on the economic mechanisms by which the imprecise measurement of potential output may affect policy behavior and thus the dynamics of inflation, their quantitative findings depend on the assumptions about the information set available to the policymaker. This study shows that when the real unit labor cost is observed or not neglected, the error in forecasting the output gap becomes quantitatively negligible. As a consequence, the optimal policy does not deviate substantially

from its ideal benchmark of full information and, in turn, potential output uncertainty does not produce quantitatively noticeable consequences for inflation dynamics.

The relevance of these findings suggests that some working assumptions are worth further investigation. First, it is important to understand to what extent these results depend on the linear-quadratic framework used. In this context, uncertainty and imperfect information do not influence the optimal policy because optimal policy is characterized by certainty equivalence. Second, the small DSGE model estimated in Lippi and Neri (2007) and Delle Chiaie (2007) is very simple and therefore potentially misspecified. One extension could be integrating capital accumulation, sticky wages and capital adjustment costs in the analysis. This issue is left for future research.

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