Flexible inflation targeting – how should central banks take the real economy into consideration?

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Inflation targeting central banks frequently express that their policy is flexible. This means that when setting the policy rate they not only try to attain the inflation target, but also strive to stabilise real economic developments. To date, however, central banks have found it hard in practice to be precise about what stabilising the real economy means. One of the difficulties lies in defining and estimating the relevant measure of "potential output". This article describes alternative ways of defining potential output and discusses which definition is most appropriate from a monetary policy perspective.

Today, there are more than 20 central banks that conduct monetary policy with an inflation target. These central banks formulate their targets similarly in many respects, though there are, of course, differences in the details. All inflation targeting countries have, for instance, chosen to announce a quantitative objective for inflation, for example 2 per cent. They are also explicit about how to measure inflation for this purpose, for example as the annual percentage change in the consumer price index (CPI). Another common denominator is the practice of publishing forecasts and assessments on which monetary policy decisions are based. Moreover, all inflation targeting central banks conduct what is now commonly known as flexible inflation targeting. [2, 3]

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[2] The term "flexible inflation targeting" was introduced by Svensson (1999). It was defined as a situation where the central bank was minimising a quadratic loss function consisting of inflation's deviation from its target as well as output's deviation from its potential level. A central bank that focused solely on inflation's deviation from its target was said to be conducting strict inflation targeting.

[3] See Kuttner (2004) for an account of how countries with an inflation target formulate these targets.

Inflation targeting equals flexible inflation targeting in practice.

In simple terms, flexible inflation targeting means that the central bank sets its policy rate so as to stabilise inflation around the targeted rate and also stabilise the real economy. In practice, however, there are different ways of expressing this flexibility.

Some countries have chosen to define the inflation target in terms of a measure of core inflation, usually calculated as CPI inflation excluding price movements for certain goods and services. The purpose of excluding certain components of the CPI is to get an inflation measure that is less affected by short-run changes on the supply side of the economy. Supply shocks in oil-producing countries, for example, can lead to temporarily higher oil prices and thereby to a temporary increase in CPI inflation. By basing monetary policy deliberations on a measure of core inflation that excludes oil prices, the central bank reduces the risk of its policy accentuating real economic fluctuations, for instance in output, employment or unemployment. Formulating the inflation target in terms of core inflation can therefore be seen as a way of paying consideration to real economic developments, that is, it can be interpreted as flexible inflation targeting.

Another way of expressing that inflation targeting is flexible concerns the target horizon and how quickly the central bank tries to bring inflation back to the targeted rate after a deviation. Central banks usually state that under normal circumstances, inflation is to be brought back to target within a specified period, for example two years. They may also state that a slower return than normal may be reasonable in the event of a shock that is unusually large. The reason for this is that a policy for a rapid return to the target could generate unnecessary fluctuations in the real economy. Escape clauses of this type mean that the central bank does not focus solely on inflation when setting its policy rate and can thereby be seen as another way of expressing what we think of as flexible inflation targeting.

There is, however, a discrepancy between flexibility's manifestation in practice and what the scientific literature recommends. Theory requires that under flexible inflation targeting, each monetary policy decision shall entail a trade-off between inflation's deviation from the target and real economic stability. The academic literature on monetary policy recommends that this is done explicitly in order to clarify the central bank's view of both sides of the trade-off. In practice, the real economy is taken into consideration rather indirectly. So the discrepancy primarily concerns the appraisal of real economic stability and how it should be measured. Given the lack of agreement about and the difficulties involved in

measuring real economic stability, most central banks have not yet been particularly clear about what they mean by it.

Norges Bank is currently the central bank that comes closest to working in accordance with the theoretical notion of flexible inflation targeting. Norges Bank publishes forecasts for the policy rate, inflation and a measure of the output gap as a proxy for real economic stability. Moreover, monetary policy decisions are motivated with reference to an explicit trade-off between inflation's target deviation and real economic stability. This begs the question why other central banks have not followed this example. A probable explanation is that a numerical forecast of real economic stability is far more difficult to produce than a number for future inflation. So let us look at what the concept of real economic stability stands for and why it has become such a central issue in the academic literature.

Potential output can be defined in various ways

Real economic development is obviously crucial for a country's prosperity. Higher growth creates possibilities of greater welfare. Low unemployment is preferable to high, et cetera. However, monetary policy cannot effect the real economy in the long run. Research and experience both show that attempts to achieve permanently lower unemployment or higher growth are bound to fail. This is because monetary policy can create higher economic activity only by generating unexpectedly high inflation. So a monetary policy for permanently higher activity has to take economic agents continuously by surprise. When people realise that the central bank is intent on an increasingly expansionary policy, they will adjust their expectations to higher and higher inflation. As a result, actual and expected inflation will both rise but there will be no effect on economic activity. It is simply not possible to delude economic agents systematically. So today there is fairly general agreement about monetary policy being neutral in the long run, that is to say, it cannot exert a permanent effect on real economic developments. What monetary policy can do, on the other hand, apart from stabilising inflation, is to reduce fluctuations in real economic activity around a "potential" level, that is, to stabilise the real economy.

So what does the concept potential level stand for? There is actually no single generally accepted definition of this concept, as regards either output or other variables, for example unemployment and employment.[4]

[4] Rogerson (1997) exemplifies the confusion that exists about concepts such as the NAIRU, natural unemployment, equilibrium unemployment, et cetera, and considers that just a few of these concepts are adequately defined in modern research. However, as the article starts from an entirely real model, it is not particularly relevant when discussing what measure of potential output is appropriate for monetary policy.

Some economists appear to equate potential output with efficient output, that is, the hypothetical level output would reach if all factors of production were fully utilised and there were no imperfections in the form of, for example, distortionary taxes, imperfect competition or price and wage rigidities.[5] Others seem to envisage some form of average or trend output. It is not hard to see that these are two different notions. The first, potential output as the hypothetically efficient level, means that in practice the economy will presumably always be below its potential output. The other, trend output, equates potential output with the average level.

A third definition sees potential output as the hypothetical level that would be reached if all prices and wages were entirely flexible but there were still real distortions, such as taxes and imperfect competition. This notion of potential output is known as flexprice output.[6]

The difference between actual and potential output is commonly known as the output gap. Estimations of the output gap will differ, depending on whether potential output is defined as efficient output, trend output or flexprice output. So which definition of potential output is most appropriate in the context of monetary policy?

General equilibrium

Modern macro economics is increasingly based on general equilibrium and that is the starting point for this article. What, then, do we mean by general equilibrium theory or general equilibrium models?[7] Simplifying somewhat, general equilibrium implies that if we have a theory for explaining or understanding a number of economic parameters or variables (consumption and income, for example), then all these variables must be determined within the framework for the theory in question. In the case of partial equilibrium, we can, for instance, have a given development of income and a theory for how households then determine their consumption. With a general equilibrium model, on the other hand, the development of income is also determined within the model's framework. In general equilibrium, moreover, prices and quantities invariably adjust so that supply equals demand in every market (financial markets as well

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5 The term "full utilisation of factors of production" may not be entirely clear because the supply of labour and capital, for example, vary. Instead of delving deeper into this problem, we can interpret the full utilisation of factors of production as a situation with no unemployment and fully utilised capital stocks.

6 Potential level is sometimes also defined as the level that is compatible with a stable rate of inflation, that is, a level at which inflation neither rises nor falls. For unemployment, the potential level according to this definition is often referred to as the NAIRU or the "Non-Accelerating Inflation Rate of Unemployment". But as this definition of potential output has not left much mark on monetary policy research, it is not considered in this article.

7 The words "theory" and "model" are used synonymously in this article because all economic models are based on some economic theory and modern economic theory can mostly be described in the form of an economic model.

as factor and product markets). That is, in fact, what general equilibrium implies.

General equilibrium theory has existed and been used for a long time. The original general equilibrium models required a number of simplifying assumptions because otherwise they would have been excessively extensive and complex. Common assumptions were that all prices and wages are entirely flexible and that perfect competition reigns in every market. With the theory's application to a growing variety of issues, however, the basic assumptions had to be changed to get a better fit between the models and actual economic developments. Price or wage rigidities and some form of imperfect competition, for example, are now the rule rather than the exception in general equilibrium models. Models that incorporate such rigidities have proved to possess sound forecasting properties.[8]

The growing prevalence of general equilibrium as a foundation for macro economic theory also has consequences for terminology. In general equilibrium theory there is, for instance, no mention of disequilibria. The notion of general equilibrium embodies an endeavour to understand observed phenomena in a model within which all the variables are determined and where supply equals demand in every market. Actual output, like every other variable, can be seen as the outcome of an equilibrium that arises through the interaction of all the agents in the economy – households, firms, the central bank and the government. So in general equilibrium theory, "equilibrium output" is synonymous with "actual output".

Equilibrium output is, in fact, a term that is sometimes used to denote potential output. Similarly, equilibrium unemployment is sometimes used for the level of unemployment that is compatible with a stable rate of inflation. That is a terminology which I deplore: in general equilibrium, equilibrium output is equivalent to actual output, just as equilibrium unemployment is the same as actual unemployment. Denoting potential output as output's equilibrium level does not help us to arrive at the level of output which a central bank should aim for when stabilising actual output. So let us take a look at some other concepts that, unlike equilibrium output, can promote an understanding of which definition of potential output is relevant for monetary policy.

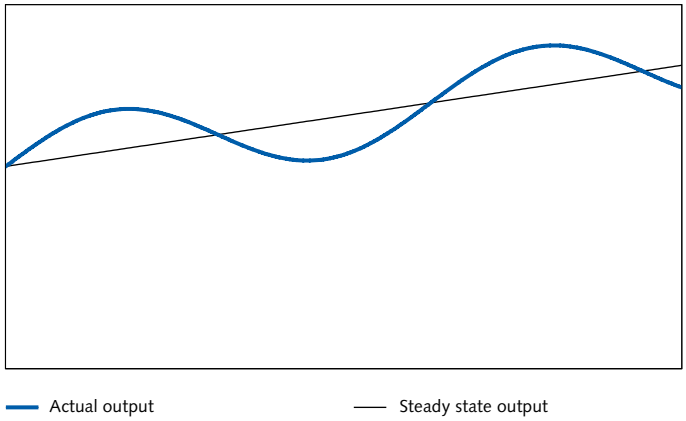
Steady state as a measure of potential output

Steady state, a concept that frequently features in general equilibrium theory, for example, refers to the state of the economy in the absence of new shocks when effects of all earlier shocks have faded away. Steady

[8] See Christiano, Eichenbaum, & Evans (2005), Smets & Wouters (2003), and Adolfson et. al (2005).

state is a hypothetical state that does not occur in practice because new shocks occur all the time. An alternative term for steady state, long-run equilibrium, is unsatisfactory for two reasons. One is that, as mentioned earlier, there are no disequilibria in general equilibrium theory (all outcomes are assumed to represent equilibria), so a reference to equilibrium does not add anything. The other reason is that the epithet long run is misleading because it suggests that the state will occur sooner or later, whereas steady state is, as mentioned, a hypothetical construct that does not arise in practice in either the short or the long run. Steady state is therefore the preferred term. Enough of terminology; Chart 1 presents a schematic picture of actual and steady state output.

Chart 1. Schematic representation of actual and steady state output.

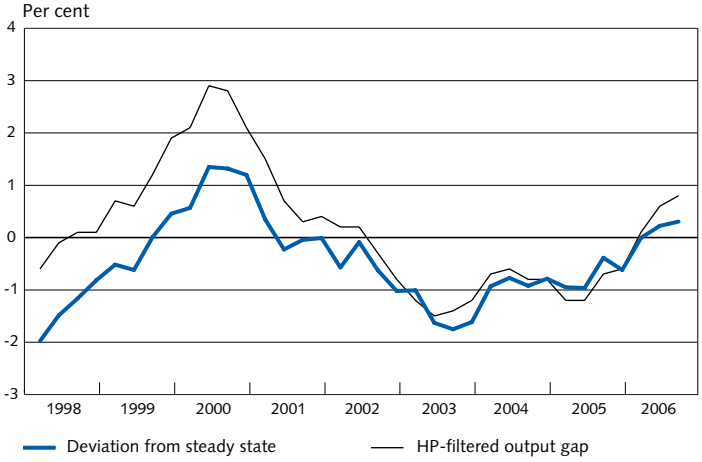


As we see, actual output fluctuates around the trend that represents output in the steady state. A common everyday term for the gap between actual and trend output is the business cycle. In practice, steady state output is not necessarily represented by an exactly linear trend. There are, however, just a few factors that can permanently alter the average growth of output, for instance research and development, education, and changes of a demographic and institutional nature (see for example Barro & Sala-i-Martin, 1995).

As it is a hypothetical concept, steady state output is not directly observable. Econometric methods are therefore commonly used to decompose actual output into a cyclical component and a trend that is derived by estimating output in the steady state. One method involves fitting a trend to data with an HP-filter. Alternatively, steady state output can be estimated with the aid of a general equilibrium model. Estimated business cycles (the gap between actual and steady state output), calculated with

an HP-filter and as deviations from the steady state in the Riksbank's macro model, RAMSES, are presented in Chart 2.[9]

Chart 2. Output gap calculated with an HP-filter and as the deviations from the steady state in the Riksbank's macro model, RAMSES.
Per cent



Sources: Statistics Sweden and the Riksbank.

The pictures provided by these alternative ways of calculating the business cycle are fairly similar: the timing of the peaks and troughs is more or less the same, though the levels differ now and then. The similarity is not surprising because these are basically just two different ways of trying to estimate the same thing. In many respects, both ways of calculating trend output resemble the process of fitting a linear trend. With the HP-filter the trend is not entirely linear; instead, a smooth trend is fitted that partly follows actual output. In RAMSES the steady state also follows a smooth trend. Output in the steady state is driven by a permanent productivity shock, that is, a productivity shock with permanent effects on productive capacity. As the permanent productivity shock is relatively stable in practice, the steady state in RAMSES also resembles a linear trend.

As mentioned in the introduction, there is no single, generally accepted definition of potential output. One possibility would be to define potential output as output in the steady state, which in practice is roughly tantamount to calculating the business cycle as the difference between actual and trend output. Does this mean that central banks ought to focus policy on stabilising such business cycles?

[9] For a decription of RAMSES, see Adolfson *et. al* (2007).

Stabilisation policy should not eliminate business cycles

A common argument in the debate on stabilisation policy is that the role of this policy is to eliminate business cycles, calculated as actual output's deviation from the steady state. The argument is frequently based on the notion of consumption smoothing, which refers to households' preference for a smooth as opposed to a fluctuating development of consumption. This suggests that besides stabilising inflation around the target, a central bank should try to eliminate the cyclical variations. To understand why this argument is misleading, we need to analyse the causes of variations in consumption.

One reason why consumption varies over time has to do with the variations in productivity. In this case, consumption smoothing can be illustrated by giving households a choice between two paths for productivity: one that sticks to the trend and another that fluctuates around this trend. Households would choose the stable development of productivity because that gives rise to a smoother development of consumption. From this it follows that it would be desirable to eliminate the cause of the variation in consumption, in this case the fluctuations in productivity.

But even if it is desirable to eliminate all variations in either productivity or other causes of business cycles, that cannot be achieved with either monetary or fiscal policy. Stabilisation policy simply cannot bring about a stable development of productivity. Instead, the question stabilisation policy faces is as follows: Given that productivity, for example, varies over time, should or should not policy focus on eliminating the consequences of these variations?

According to the academic literature, it would not be optimal for stabilisation policy to aim for the total elimination of all cyclical variations. The reason for this is easiest to understand by studying a neoclassical general equilibrium model, that is, a model with perfect competition in every market and no rigidities or other imperfections. In such a model, business cycles arise as efficient responses to the occurrence of shocks, for example productivity shocks.[10] As all responses are efficient, in terms of welfare there is nothing a central bank or a government can do to improve the outcome for consumers and consequently there is no point in trying to eliminate business cycles.

Even when price or wage rigidities are included in the model, business cycles can arise in the same way. With such nominal rigidities, however, prices do not adjust to the same extent as in the neoclassical model. With price rigidities, output's response to a productivity shock,

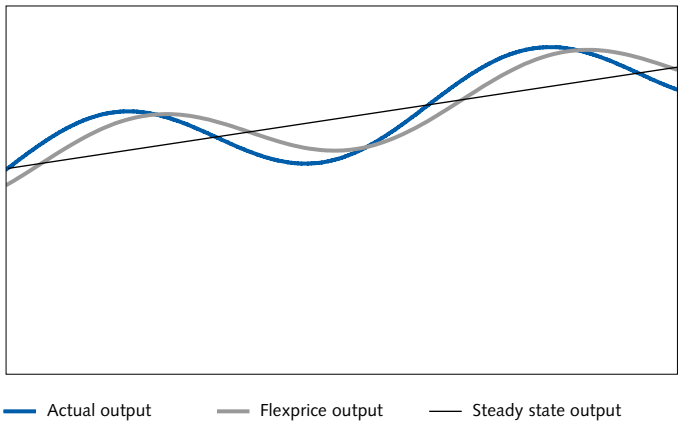
[10] See Kydland & Prescott (1982).

for instance, will not be efficient and as the responses are inefficient, there is room for welfare improvements. That is why monetary policy research indicates that central banks ought to pay *some* consideration to the real economy when setting the policy rate. How is this to be done? As the *total* elimination of business cycles is not optimal in a model with fully flexible prices, neither is it optimal in a model with price rigidities. So instead of eliminating business cycles, the best thing a central bank can do in a model with price rigidities is rather to aim for a cyclical path that resembles what would have occurred if prices had been flexible, which brings us to the concept of flexprice output.

Flexprice output is the most relevant measure of potential output

As mentioned earlier, it is becoming increasingly common for general equilibrium models to incorporate rigidities in prices and wages, for example. This has led to the introduction of the concept of flexprice output, which represents the output that would have occurred, given that all prices (including wages) are fully flexible. This is a hypothetical measure and a deviation from flexprice output is called the flexprice gap. A schematic representation of flexprice output is shown in Chart 3 together with actual and steady state outputs.

Chart 3. Schematic representation of actual, flexprice and steady state outputs.



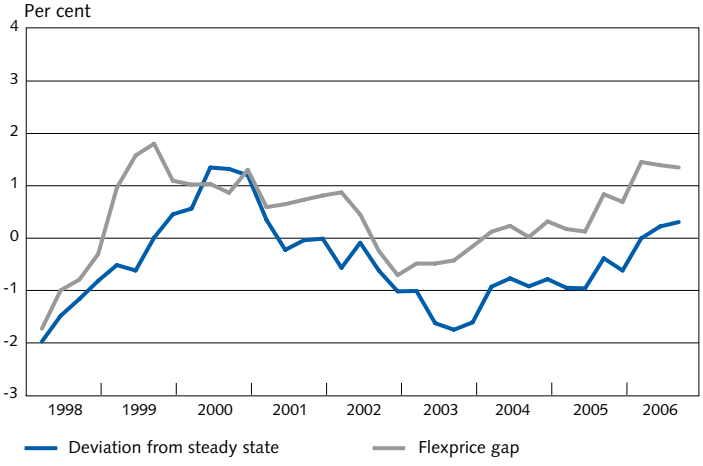
As we see, actual and flexprice output both fluctuate around the same steady state. The driving forces on flexprice output are in principle the same as those on actual output, for instance productivity shocks. This is very different from steady state output, which is affected by just a few matters. The similarity between the influences on flexprice and actual

output has to do with how the two are defined: the only difference is that flexible prices are assumed for flexprice output and price rigidities for actual output. If price rigidities are very small, flexprice output will not differ greatly from actual output; an increase in productivity, for example, will raise both flexprice and actual output to much the same extent. With very rigid prices, on the other hand, increased productivity will result in a larger difference. As flexprice and actual output are influenced in a similar manner, one of them cannot be studied or forecast independently of the other. They are closely inter-related and have to be estimated within the framework of one and the same model.

Flexprice output has recently been attracting more and more attention in monetary policy research. Woodford (1999) argues that it is precisely flexprice output which is the relevant measure of potential output for monetary policy. In other words, a central bank ought to aim to minimise actual output's fluctuations around this varying flexprice output. Svensson (2006) voices a similar opinion. One of the underlying reasons is the presumed desirability of monetary policy reducing or eliminating the consequences of price and wage rigidities.

The Riksbank's macro model, RAMSES, mentioned above, can also be used to calculate flexprice output.[11] Output gaps calculated as the flexprice gap and the deviation from steady state, respectively, are presented in Chart 4.

Chart 4. Deviations from steady state and flexprice gap according to the Riksbank's macro model, RAMSES.
Per cent



Sources: Statistics Sweden and the Riksbank.

[11] The version of RAMSES that is normally used includes both price and wage rigidities; this version is estimated on real-life data and one of its results is an output gap that measures output's deviation from the steady state. Flexprice output is obtained with the same model and parameter estimates except that price and wage rigidities are set to zero; flexprice output is then obtained by introducing the shocks, for instance from productivity, that have been identified in the version with price and wage rigidities.

When we compared an HP-filtered output gap with an output gap calculated as the deviation from steady state, the main difference was in the output gap's level, while the timing of peaks and troughs was relatively similar. The flexprice gap gives a somewhat different picture, as one might expect since the two measures are based on different definitions of potential output. The flexprice gap indicates, for instance, that flexprice output was already exceeded by actual output early in 1999, whereas the latter did not exceed steady state output until almost a year later. The two ways of defining potential output give a similar discrepancy in the picture of the current situation: actual output has been above flexprice output ever since the beginning of 2004 whereas it did not exceed steady state output until the summer of 2006.

Flexprice output accordingly indicates what output would be if prices and wages were fully flexible. If price and wage rigidities were the only imperfections in the economy, the central bank should take the real economy into consideration by stabilising the flexprice gap as well as inflation's deviation from the target. In practice, however, other imperfections are at work, for instance in product markets. So what are the implications of these and other imperfections for the measure of potential output that is relevant for monetary policy?

Other imperfections also exist in practice

The case for taking the real economy into consideration by stabilising the flexprice gap is valid only if price or wage rigidities are the economy's only imperfections. Given imperfect competition in product markets, firms will set prices as a mark-up over marginal costs. Prices will then be higher and the volume of output lower than with perfect competition. So even if all prices and wages were fully flexible, average output would be unduly low. Thus, flexprice output is inefficient under imperfect competition. So a central bank that aims to stabilise the flexprice gap will not produce the best possible outcome for consumers.

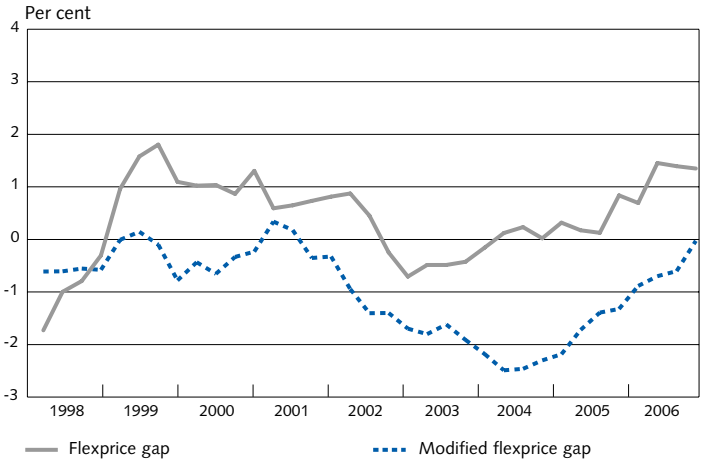
A common assumption in general equilibrium models such as RAMSES is that the price mark-up varies over time, which means that flexprice output varies over time as a direct consequence of mark-up changes.[12] Under perfect competition, on the other hand, price mark-ups are constant over time. So in order to approximate efficient output under perfect competition, the variations in price mark-ups must be turned off in the model, as well as the price and wage rigidities.[13]

[12] For a study of the effects of mark-ups on inflation, see Jonsson (2007).

[13] Just shutting off the variations in price mark-ups is not sufficient in practice. The model is calibrated around a steady state with an average price mark-up that is greater than one, that is, output in the steady state is too low. Benigno & Woodford (2005) demonstrate how a welfare-relevant measure of potential output can be calculated when the steady state is inefficient due to imperfect competition in product markets.

In RAMSES it is not only price mark-up variations that give rise to a difference between flexprice output and efficient output. There is, for example, the assumption that monetary policy follows a Taylor rule, which simplifying somewhat means that the policy rate is set as a function of inflation's deviation from the target and a measure of the output gap.[14] The monetary policy rule also includes a monetary policy shock: a measure of how well the rule manages to predict actual policy rate adjustments. Such monetary policy shocks have some effect on flexprice output but not on efficient output. Chart 5 presents a modified flexprice gap when some of these factors have been turned off and price and wage rigidities are set to zero.

Chart 5. Pure and modified flexprice gaps according to the Riksbank's macro model, RAMSES.



Note. Calculating the modified flexprice gap involves setting all price and wage rigidities to zero and shutting off all variations in price mark-ups, monetary policy shocks, deviations from UIP and shocks to the inflation target.

Sources: Statistics Sweden and the Riksbank.

As Chart 5 shows, these two ways of defining potential output also give different estimates of the output gap. We are accustomed to the uncertainty in forecasts of future inflation, whereas current inflation is a more definite quantity. The uncertainty about the output gap is of a different kind. It concerns the most correct way of the defining the measure of potential output that is relevant for monetary policy and the choice results in relatively large differences in the picture of the current situation. Arriving at numerical forecasts for the measure of the output gap that is relevant for monetary policy is therefore an order of magnitude more difficult than forecasting a number for inflation.

[14] In practice, the monetary policy rule also includes the previous period's interest rate and the changes in inflation and the output gap as well as the real exchange rate.

Real economic stability in the future

Of the more than 20 countries that target inflation, a majority can be seen as examples of flexible inflation targeting. But it is only Norges Bank that publishes output gap forecasts and motivates its decisions with an explicit trade-off between inflation's deviation from the target and the path of the output gap. It is noteworthy, however, that Norges Bank recently attracted some criticism for not being clear enough in its opinion about potential output and that the latter should not be represented by output's trend level.[15]

In order to conduct a policy in line with the theoretical definition of flexible inflation targeting and present a clearer view of real economic stability, it is necessary to form an opinion about the measure of potential output that is relevant for monetary policy. This measure clearly cannot be obtained with simple traditional methods for fitting a trend to data. Neither does it seem possible to calculate without a model that includes all the main markets, rigidities and imperfections. In the absence of such a model, one can hardly form an opinion about what output would be if, for example, prices were fully flexible. General equilibrium models can admittedly serve to calculate a flexprice gap and other welfare-relevant measures of the output gap. But not even with such models is it a simple matter to define and calculate the measure of potential output that is relevant for monetary policy. The treatment of capital stocks in a calculation of flexprice output is, for example, not self-evident. Should flexprice output be seen as the level of output that would be reached if prices and wages are flexible in the future but the existing capital stock is taken as given? Or should the capital stock be calculated as the hypothetical stock that would exist today if prices and wages had been flexible since the beginning of time?

Even if general equilibrium models are included in forecasting work by more and more central banks, they are only one of many ingredients in the final forecast. They do not comprise all the available information about economic developments; assessments by sector specialists and forecasts from time series models also contribute to the final result. Central banks' overall "model" of the economy in a wider sense is obtained as a weighted mix of all these ingredients. So how should a welfare-relevant measure of potential output be calculated when the final forecast consists of an implicit mixture of all the various ingredients? No central bank has yet fully integrated a general equilibrium model in its forecasting work, so it is perhaps hardly surprising that most central banks are not particularly precise about their view of real economic stability. It is reasonable to suppose that in future these models will continued to be

[15] See Goodfriend et al. (2007)

developed and integrated in monetary policy analyses by more and more central banks. As the picture of the measure of potential output that is relevant for monetary policy becomes clearer, it is also reasonable to suppose that central banks will become clearer in their view of the part that real economic stability plays in monetary policy decisions.

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