Box 5 Central bank policy decisions using Taylor rules

Ever since John Taylor (1993) demonstrated that the Federal Funds rate (the Federal Reserve interest rate instrument) movements over the period 1987-1992 could largely be explained by movements in inflation and the output gap, "Taylor rules" have become increasingly popular in theoretical and general discussion of monetary policy. One of the most common forms of the Taylor rule states that deviations of the central bank policy rate from an equilibrium interest rate, which reflects a neutral policy stance, are a positive function of deviations of inflation from the inflation target of the central bank and deviations of output from potential output. This equilibrium interest rate, on the other hand, is composed of the equilibrium real interest rate and the inflation target.

Formally, this simple Taylor rule may be expressed as follows:

$$i_t = (r^* + \pi^*) + \beta(\pi_t - \pi^*) + \gamma x_t$$

where i_t is the central bank policy rate, π^* is the central bank's inflation target, π_t is actual inflation and x_t is the output gap, i.e. output produced in excess of the production capacity of the economy. r^* is what is usually called the neutral, or equilibrium, real interest rate, i.e. the level of real interest that reflects internal and external balance in the economy. This is determined, among other things, by real factors such as the productivity of capital, the level of saving and the steady state growth rate of the economy. According to this simple rule, the central bank policy rate is determined by four factors. The first two are the equilibrium real interest rate and the inflation target. Together, these provide a benchmark recommendation for the central bank's nominal policy rate. The third factor adjusts this benchmark for the degree to which inflation deviates from the target. If inflation exceeds the target, the rule recommends raising the policy rate above the benchmark and lowering the policy rate below the target if inflation is below the target. Finally, the benchmark is adjusted for the degree to which actual output deviates from potential output. If there is a positive output gap, the factors of production are overutilised with a greater risk of inflation. The rule recommends raising the policy rate above the benchmark in this case. The opposite applies when the output gap is negative. When inflation is equal to the inflation target and output equal to potential, the central bank's equilibrium nominal policy rate, according to the rule, is the sum of the equilibrium real rate and the inflation target. This interest rate can be considered neutral in the context of the rule.

In order to be able to use the Taylor rule, the equilibrium real rate must be quantified, along with the response parameters for the inflation and output gaps. In his article from 1993, Taylor found that such a rule, where $r^* = \pi^* = 2\%$, $\beta = 1½$ and $\gamma = ½$, produced an amazingly accurate description of the Federal Reserve's interest rate decisions over the period 1987-1992. It seemed incredibly that such a complex process as US monetary policy decisions could be described with such a simple rule. Other research has followed, showing that this same rule also seems describes the behaviour of other central banks (e.g. the Bank of England after it adopted inflation targeting, Nelson (2001), and the central banks of Japan, Germany, France and Italy, Clarida, Galí and Gertler (1998)). Since this rule has been able to describe periods when monetary policy decisions have been considered successful, there has been growing support for the view that Taylor's rule, or some variations of the simple rule, provides a good rule recommendation for monetary policy decisions.

The choice of suitable parameters for the Taylor rule probably depend on time and place. Thus it can be argued that an economy like Iceland, which can probably grow faster in steady state than the larger and more developed US economy, would require a higher real interest rates in order to maintain economic equilibrium. The equilibrium real rate will therefore be higher than, for example, in the USA. The response parameters could also be different. It is, however, necessary that $\beta > 1$, in order for the rule to return a rate of inflation that is compatible with the inflation target.

The reason is that β reflects the response of the nominal policy rate to an increase in inflation. If $\beta < 1$, the rise in the policy rate would never manage to offset the rise in inflation, so that the real policy rate would fall instead of rising. The Central Bank will therefore never manage to squeeze the excess demand that caused inflation to rise out of the economy, so that the inflation target will never be attained. In such a case the Taylor rule would be unstable and would not provide a nominal anchor for monetary policy.

Despite its many advantages, the Taylor rule also has various flaws which make it difficult to apply it directly as a guide for actual policy decisions. Firstly, it is really too simple to reflect all the information that central banks consider in their interest rate decisions. Central banks are likely to want to take advantage of other data which are not clearly reflected in the Taylor rule, for example concerning exchange rate developments, other asset price developments, and the development of money supply and lending. Secondly, it is unclear what the response parameters for the Taylor rule should be at any given time and there is considerable uncertainty about the actual value of the equilibrium real interest rate. Similarly, it is unclear what measures of inflation and output gap should be used in the rule, and what the timing of these variables should be. Inflation can be measured in many ways: e.g. using past 12-month changes or quarterly year-on-year changes, and likewise many price indices could be considered: consumer prices, some measures of core inflation and the implicit GDP price index. It is not clear either whether the contemporary value of inflation over a previous period, lagged inflation or forecast inflation should be used, and if the latter is used, how far into the future such a forecast should project. The same kind of questions arise regarding the output gap, which moreover is not measured but needs to be estimated using statistical methods. Major uncertainties accompany such an evaluation, reflected in frequent revisions of historical data on the output gap. Finally, it can be mentioned that the Taylor rule in its most simple form does not take into account the tendency of central banks to smooth movements in interest rates, which appears to be rooted in part in their role of safeguarding financial stability and promoting active financial markets, as well as reflecting their wish to implement interest rate changes in many small steps rather than one large one, due to uncertainty concerning the effects of policy changes on inflation and the output gap.

Due to these difficulties, central banks generally do not use the Taylor rule directly in their monetary decisions. However, the rule can prove useful in other ways. For example, central banks can use it as one of many internal tools in the interest rate decision-making process. The rule can be used as the starting point for the decision process, and as a benchmark to assess actual interest rate decisions which are based on all relevant information available in order to understand why actual policy decisions do not conform to the recommendations of the rule. By doing so, a central bank could strengthen its interest rate decision process even further. In addition, central banks can use the rule in their forecasting models and to assess the effects of different economic shocks on the economy, and of the policy responses that would follow. An example of the latter is the way the Central Bank has used the rule in assessing the likely monetary policy responses to the Reydarál aluminium project (see Appendix 1 on p. 28). Finally, central banks can use the Taylor rule as a convenient communication tool for focusing the discussion on monetary policy decisions and to educate the general public and government about key issues on monetary policy, and to improve their understanding on the interest rate decision-making process.

To conclude, a few examples will be given to show how the Taylor rule can be applied. As a rough estimate, the equilibrium real interest rate in Iceland could lie between 3 and 4%, which is somewhat higher than is generally assumed for large industrial countries. Given the 2½% inflation target of the Bank, the neutral nominal policy rate lies between 5½ and 6½%. These numbers should give some indication as to where the Central Bank policy rate could head towards once the inflation and output gaps disappear.

Another example concerns the policy rate last year. At the time inflation exceeded 9% for a short period and the Bank's estimate for the output gap was 3%. Inserting these numbers into the Taylor rule produces a policy rate of around 17%, compared to the peak in the

policy rate of 11.4% from November 2000 to the end of March 2001. Even using inflation over the year 2001, which was somewhat lower, gives a policy rate between 13 and 14%. Although these findings must be taken with some reservation, partly because they do not take into account the tendency of central banks to smooth movements in interest rates, they nonetheless underline that it is easier to claim that the Bank's policy rate was too low rather than too high last year, despite the widespread view to the contrary.

The final example presented here concerns the current situation. According to the newest forecasts, the output gap will be slightly negative this year. Underlying inflation in recent months is probably around 4%. The Bank's inflation forecast for one year ahead is just over 3%. Inserting these numbers into the Taylor rule produces gives a policy rate between 7 and 8½%. This gives some indication as to where the Central Bank policy rate could head in the months to come, when uncertainty concerning the labour market agreement have been dispelled and inflation decreases according to the Bank's forecast. It should be underlined that these calculations are only for demonstration. Actual monetary policy decisions and their timing are always based on a much more complex evaluation of the state of the economy, as discussed above.

References

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