Taylor interest rate and Monetary Conditions Index

Two monetary policy indicators which have received a fairly large amount of attention in the nineties are the Taylor interest rate and the Monetary Conditions Index (MCI). The Taylor rule, which was constructed by the US economist John Taylor, makes the short-term interest rate dependent on current inflationary and cyclical developments. The MCI, which was developed by the Bank of Canada, combines changes in the short-term real interest rate and in the real effective exchange rate in a single variable. This is intended to take account of the role of both variables in the monetary policy transmission process. Both the Taylor interest rate and the MCI are also used by outside monetary policy analysts to assess the policy of the Eurosystem (and were used formerly to assess that of the Bundesbank). Moreover, they are recommended for use by the central banks themselves. One likely main reason for their popularity is that they appear at first glance to be simple and easy to understand. However, the following comments reveal that both indicators have some shortcomings. These are due, firstly, to uncertainties in their computation and, secondly, to weaknesses in their design. The Taylor interest rate and the MCI are therefore suitable, at best, as broad reference variables and have to be interpreted with due caution.

The role of monetary policy indicators

Necessity of monetary policy indicators

Long and variable time lags and the fact that the structural relationships in the economy are not fully known mean that central banks are unable to exercise direct and sufficiently precise control over either the overall price level or other possible ultimate target variables. In order to assess the current monetary situation, central banks therefore require, firstly, variables which contain information on the future development of the ultimate target variable(s) (leading indicators). Secondly, they need variables which make it possible to assess the impact of their own policy (policy indicators). Some indicators – such as the money stock M3 up to the end of 1998 in Germany – can perform both functions simultaneously in a satisfactory manner, whereas others are not able to do so at all, or only with regard to one function.

The lack of an ideal indicator in practice ...

An ideal indicator, which invariably gives a reliable indication of the future development of the ultimate target variable(s) and gives clear-cut information on the course of monetary policy, is not available in practice. As a rule, central banks therefore make use of a broad range of indicators. This does not preclude certain indicators being assigned a prominent role because they have particularly good indicator properties. The broadly defined monetary aggregate M3, for example, has a special position within the monetary policy strategy of the Eurosystem. The fact that there is no variable which adequately reflects all the relevant information leads to the constant development of

... encourages the development of new concepts

new indicators. In the nineties, two concepts, in particular, have been given a certain amount of attention by a number of central banks, financial market participants and international organisations: the Taylor interest rate and the Monetary Conditions Index (MCI).

The Taylor interest rate

Construction of the Taylor interest rate

The monetary policy rule presented by John Taylor in 1993 postulates that the central bank should base the setting of the short-term interest rate on the current situation with regard to inflation and the business cycle:[1]

Taylor interest rate = real equilibrium interest rate
+(expected) inflation rate
+ $a_P \cdot$ output gap
+ $a_I \cdot$ inflation gap.

The output gap is the relative difference between the actual and the potential output level, the inflation gap is the difference between the measured inflation rate and the rate of inflation which the central bank aims for. Both variables are included in the Taylor interest rate with a positive weighting of a_P and a_I, respectively. This reflects the idea that an excessive price rise and an overutilisation of production capacity should be counteracted by a higher short-term interest rate and vice versa. Accordingly, given full use of capacity and realisation of the envisaged rate of

1 Strictly speaking, a monetary policy rule is understood to mean a formula-like advance determination of monetary policy. Taylor himself, however, sees the potential application of his "rule" more as a guideline and thus as a (prominent) indicator. The character of an indicator variable tends to be assigned to the Taylor interest rate in practical applications, too. As in the economic science literature, frequent reference is made to the "Taylor rule" in the present article. However, the comments made apply equally to the use of the Taylor interest rate as a monetary policy indicator.

inflation, the "real equilibrium interest rate" is the level of the real rate of interest at which the long-term equilibrium is not changed by monetary policy. The (expected) inflation rate is added to the sum of these three components to make the Taylor interest rate comparable with the relevant nominal interest rate.

Taylor achieves quite good approximation of the US short-term interest rate ...

In his original paper, Taylor applied the concept subsequently named after him to US monetary policy from 1987 to 1992.[2] For his deliberately simple calculation, he selected the following approximations of the non-observable variables: he substituted the realised inflation rate of the preceding four quarters for the expected inflation rate over the same period, assumed a 2.2 % annual rate of growth for the production potential (which corresponds to the trend growth of real income in the United States between 1984 and 1992), set the equilibrium real short-term rate of interest at 2 %[3], and calculated the inflation gap as the difference between the current inflation rate and an inflation target which is a constant 2 %. He gave equally high weighting to the inflation and output gaps, at 0.5 each. Measured by its simplicity, the Taylor interest rate thus calculated captures the behaviour of the US Federal Funds Rate in the period reviewed quite well.

... and proposes that the Eurosystem follows his rule

Taylor backs up his suggestion that this concept be used as a guideline for monetary policy in general – and, possibly with different weights, for the monetary policy of the Eurosystem in particular[4] – with the fact that his rule has proved itself in simulation studies (ranging over a large number of model economies) to be a good monetary policy guideline for stabilising inflation and output.[5] According to Taylor, although somewhat better monetary policy rules could be found for individual model economies, previous papers indicated that these (in most cases, more complicated) rules are inferior to those of the Taylor-type even under slightly changed assumptions. The robustness of a monetary policy rule in respect of changed model assumptions is important as the "true" structure of the economy is unknown.[6] According to Taylor, the risk of following an incorrect monetary policy rule, which is the risk associated with the uncertainty about the structure of the economy, is smaller using his rule than in the case of many others.

Problems in calculating the Taylor interest rate on account of ...

Calculating and using the Taylor interest rate appear at first glance to be very simple. In actual fact, however, it raises a number of practical and theoretical problems. First of all, for example, the weightings of the output and inflation gaps have to be determined. The weighting scheme used by Taylor is not necessarily appropriate.[7] The central bank's

2 See Taylor, J. B. (1993), Discretion versus policy rules in practice, Carnegie-Rochester Conference Series on Public Policy 39, p.195–214.
3 Taylor points out that this value is approximately equal to the assumed potential growth, i.e. compatible with a long-term equilibrium growth path.
4 See Taylor, J. B. (1998), The ECB and the Taylor rule. How monetary policy could unfold at Europe's new central bank, The International Economy, Vol 12/5, p. 24f and p. 58f.
5 See Taylor, J. B. (1998), The robustness and efficiency of monetary policy rules as guidelines for interest rate setting by the European Central Bank, Conference on monetary policy rules organized by the Sveriges Riksbank and the Institute for International Economics (Stockholm University), Stockholm, June 12–13, 1998.
6 See McCallum, B. T. (1988), Robustness properties of a rule for monetary policy, Carnegie-Rochester Conference Series on Public Policy 29, p. 173–203.
7 In the United States, too, there are doubts about the equal weighting given to the inflation and output gaps. See Ball, L. (1997), Efficient rules for monetary policy, NBER Working Paper No. 5952, Cambridge, MA.

orientation and the structure of the economy have to be taken into consideration when determining the coefficients. The weights are to be estimated and are thus method-dependent. Depending on the relative weight, however, there may be considerable differences in the Taylor interest rate at different periods resulting in a correspondingly varied assessment of current monetary policy.

... degrees of freedom in selecting the price variables ...

In this connection, broadly based indices such as the consumer price index and the GDP deflator are generally suitable for calculating inflation. For Germany, both variables follow a similar path over fairly long periods. Nevertheless, there were sometimes major deviations, one of the causes of which were exchange rate movements (see below, page 54). If the real rate of interest is calculated as usual as the difference between the nominal rate of interest and the inflation rate, the choice of the price index influences that variable as well as the inflation gap.

... in estimating the output gap ...

There are also different options available for estimating the output gap. Depending on the method used for determining the potential – for example, log-linear trend, Hodrick-Prescott trend or the estimation of a production function – this may produce quite major differences which are reflected directly in the level and the behaviour of the Taylor interest rate.

... and in determining the equilibrium real short-term rate of interest

Finally, problems are raised by the setting of the equilibrium real rate of interest. This is frequently approximated by a multi-year average of the difference between the actual nominal interest rate and the inflation rate and therefore depends crucially on the period used for forming the average.[8] Furthermore, assuming a constant equilibrium real short-term rate of interest over long periods is not entirely without problems. Besides the (expected) rate of return on tangible fixed assets and the general propensity to save, the determinants of this variable include the general assessment of the uncertainty in the economy and the degree of credibility of the central bank. As the Taylor interest rate does not take changes in these factors into account, it may lead to inaccurate assessments. Overall, the Taylor interest rate therefore shows a wide range of variations, especially for individual points in time, which may amount to far more than 1 percentage point.

Design shortcomings owing to a lack of foresight ...

However, in addition to the above-mentioned computational problems, the Taylor interest rate also has some shortcomings in its design. From the point of view of practical monetary policy, a fundamental objection to orienting monetary policy to the traditional Taylor interest rate is that it does not take due account of the necessity of forward-looking behaviour. Because of the aforementioned time lags between the central bank taking its interest-rate measures and their impact on price movements, the monetary policy decision-makers should, in principle, be guided by the outlook for prices rather than by current inflation. Otherwise, monetary policy decisions will systematically be taken too late. Current

8 Most computations of the Taylor interest rate differ from Taylor's original method, which links the equilibrium real rate of interest to growth-theoretical considerations. Compared with the formation of the average, Taylor's method can lead to very low values for the equilibrium real rate of interest and hence for the Taylor interest rate.

inflation and the output gap, which are included in the Taylor interest rate, do provide a certain amount of information on future price developments. Even so, the incorporation of additional information that is held to be relevant enhances the quality of the interest rate policy.[9]

... and, in some cases, wrong signals

The Taylor rule also gives wrong signals in certain cases. For instance, it indicates a need for monetary policy action, in principle, if there is a one-off increase in the overall price level, such as one caused by an increase in value-added tax. It is possible to argue, however, that monetary policy can tolerate the "first-round effects" of such shifts in the overall price level. This shows that a prudent application of the Taylor rule calls for a more detailed analysis of the individual determinants of price level changes. Alternatively, such misdirections can also be alleviated by basing the rule on a "core inflation rate" instead of the inflation rate recorded in the statistics. Such core inflation rates attempt to eliminate purely transitory price impulses and capture merely the longer-term price trend.[10]

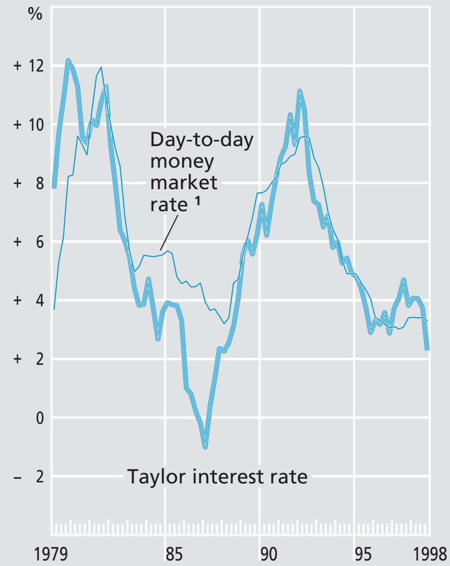
A Taylor interest rate for Germany

Calculation based on Taylor's method

The chart on this page shows the behaviour of the Taylor interest rate for Germany if it is largely calculated using Taylor's original method. The inflation and output gaps are both given an equally high weighting of 0.5 and are entered simultaneously into the Taylor interest rate. The inflation rate is based on the (west German) consumer price index, and the inflation target is the upper limit of the "unavoidable rate of inflation" (or, from

Day-to-day money market rate and Taylor interest rate for Germany

Quarterly averages



1 Day-to-day money market rate in Frankfurt.

Deutsche Bundesbank

1985, the "normative inflation") used by the Bundesbank in deriving the monetary targets. The output gap is based on the Bundesbank's potential estimation for western Germany.[11] The equilibrium real short-term rate of interest is set at 3.4%. This corresponds to the

9 This is the conclusion arrived at by a number of papers dealing with the relative advantages of different monetary policy rules. See, for example, Batini, N., Haldane, A. (1999), Monetary policy rules and inflation forecasts, Bank of England Quarterly Bulletin, February, 1999, pp. 60–67, and Rudebusch, G., Svensson, L.E.O., Policy rules for inflation targeting, in J. B. Taylor (eds.), Monetary policy rules (due to appear in summer 1999).
10 There are, however, several methods of computing core inflation rates which, in some cases, lead to differing results.
11 West German data were used as these formed the relevant database over the largest part of the period under review: even in the initial period after reunification, there was only a limited possibility of determining the Bundesbank's monetary policy on the basis of the data from eastern Germany – firstly, because the data were not sufficiently reliable and, secondly, because eastern Germany's structural problems could not be solved by monetary policy.

average of the (ex post) real day-to-day money market rate during the period under review of roughly two interest-rate cycles (first quarter of 1979 to fourth quarter of 1998).[12] When interpreting the Taylor interest rate calculated in this way, it should be borne in mind, however, that, in principle, other estimation periods, and, therefore, other average values are acceptable, too.[13]

Interest-rate smoothing not taken into consideration

The behaviour of the observed day-to-day money market rate is smoother than the Taylor interest rate calculated as described above. Other things being equal, orientation to the Taylor interest rate would have implied greater interest rate movements than the Bundesbank actually allowed on the basis of its concept.[14] The reason for the stronger movement of the Taylor interest rate is that it does not take account of the adverse implications of an overly activist monetary policy. Given uncertainties about the current and future state of the economy and its structural relationships, it is inappropriate, for example, to react in full immediately to every piece of information that is received.[15] An additional factor is that frequent interest rate movements may entail drawbacks in the shape of higher uncertainty and more difficult expectation formation. A steady monetary policy which, as far as possible, avoids sharp interest rate fluctuations, avoids these drawbacks and facilitates stabilisation.

Although there tends to be a parallel movement with the day-to-day money market rate ...

Overall, the behaviour of the day-to-day money market rate and the Taylor interest rate are quite similar. At first glance, this largely parallel movement appears to be very surprising since the output gap has not played an explicit role in Bundesbank policy. It is less surprising, however, if the similarities between the Taylor rule and monetary targeting are taken into consideration. The potential-oriented monetary targeting policy, too, has an automatic anticyclical component, for example: if gross domestic product (GDP) grows more slowly than the production potential, the central bank uses falling interest rates to provide more money than is needed to fund current growth. Furthermore, monetary targeting, too, reacts to deviations of the inflation rate from the "normative inflation" (see overview page 53).

... there are fairly major deviations in some periods

Despite the tendency to parallel movement, fairly major deviations between the day-to-day money market rate and the Taylor interest rate can be identified at certain periods. This is most obviously the case between the beginning of 1984 and early 1987, when a growing differential between the day-to-day money market rate and the Taylor interest rate emerged. However, this noticeable differential disappears almost entirely in 1985 and 1986 if the computation of the Taylor interest rate is based on the GDP deflator rather than the con-

12 During this period, the hypothesis of stationarity of the real rate of interest cannot be rejected. This indicates that the real rate of interest has a tendency to revert to its mean. This property is an essential condition for the mean value to be used informatively as an estimation variable for the equilibrium real rate of interest.
13 An estimation period from 1972, for example, produces an average real rate of interest of 2.6 %.
14 For an econometric analysis which accommodates this by incorporating a lag-dependent variable, see Clarida, R. et al. (1998), Monetary policy rules in practice: some international evidence, European Economic Review 42/6, pp. 1033–1067.
15 See, for example, Brainard, W. (1967), Uncertainty and the effectiveness of policy, American Economic Review 57/2, pp.411–425, and Goodhart, C. A. E. (1999), Central bankers and uncertainty, Bank of England Quarterly Bulletin, February, pp.102–121.

Monetary targeting and the Taylor rule

The Bundesbank derived its target growth for the money stock Δm^T from the quantity equation (except in the case of interest rate i, lower-case letters stand for logarithmic variables, and Δ stands for first differences):

(1) $\Delta m = \Delta p + \Delta y - \Delta v.$

This was based on the inflation rate envisaged over the medium term (normative inflation) Δp^T, the expected rate of growth in the real production potential Δy^*, and the trend rate of change in the velocity of circulation Δv^*:

(2) $\Delta m^T = \Delta p^T + \Delta y^* - \Delta v^*.$

If the setting of interest rates is oriented to the deviation of the money stock from its target growth

(3) $\Delta i = \lambda \cdot (\Delta m - \Delta m^T)$, with $\lambda > 0$,

and equations (1) and (2) are taken into consideration, the following interest rate rule emerges:

(4) $i = i_{-1} + \lambda \cdot \left[(\Delta p - \Delta p^T) + (\Delta y - \Delta y^*) - (\Delta v - \Delta v^*)\right].$

For better comparability with the Taylor rule, the deviation of the rate of change in the velocity of circulation can be replaced by the trend value, taking account of the money market equilibrium. Assuming a standard money demand function in the following form (ε is a stochastic residual)

(5) $\Delta m^d = -\gamma_1 \cdot \Delta i + \gamma_2 \cdot \Delta y + \Delta p + \Delta\varepsilon$, with $\gamma_1, \gamma_2 > 0$,

the following applies in accordance with equation (1) in the money market equilibrium:

(6) $\Delta v = \gamma_1 \cdot \Delta i + (1 - \gamma_2) \cdot \Delta y - \Delta\varepsilon.$

Accordingly, in the long-term equilibrium for the trend rate of change in the velocity of circulation, the linear relationship with potential growth follows:

(7) $\Delta v^* = (1 - \gamma_2) \cdot \Delta y^*.$

The interest rate rule (4) can thus be rewritten as:

(8) $i = i_{-1} + a_p \cdot (\Delta y - \Delta y^*) + a_l \cdot (\Delta p - \Delta p^T) + a_l \cdot \Delta\varepsilon,$

$$\text{with } a_l = \frac{\lambda}{1 + \lambda \cdot \gamma_1} \text{ and } a_p = a_l \cdot \gamma_2$$

Like the Taylor rule, equation (8) contains the inflation and output gaps as feedback variables. However, a closer inspection reveals some differences:

– In contrast to the Taylor rule, the target path for output relates to the growth in output and not to its level.

– The central bank responds to the feedback variables deviating from their target path by changes in the short-term interest rate from the preceding period, whereas the Taylor rule provides for an adjustment of the interest rate relative to its equilibrium value.

– Furthermore, linking interest rate policy to an intermediate monetary target as in equation (4) implies that the central bank responds not only to fluctuations in inflation and output but also to deviations of the velocity of circulation from its trend. This is based on the idea that future inflationary risks are reflected at an early stage by a rise in cash holdings.

Deutsche Bundesbank

sumer price index.[16] The reason for this is that the price trend in domestic overall output (which is measured by the GDP deflator) was very different from the price trend in the goods and services of domestic consumption (which is measured by the consumer price index). The marked appreciation of the Deutsche Mark in 1985 and 1986 led to lower prices for imported goods and, because imported consumer goods had become cheaper, lower rates of inflation based on consumer prices. By contrast, inflation based on the GDP deflator did not decline to the same extent.

Computation based on subsequently revised data

When comparing the day-to-day money market rate with the Taylor interest rate, it should also be borne in mind that the Bundesbank would have been unable to base its monetary policy decisions completely on the real-time data used here for calculating the Taylor interest rate since it is generally only in the second half of a given quarter that the GDP (and hence also the GDP deflator) of the preceding quarter becomes known. Moreover, some of these data are subject to subsequent major statistical revisions.[17]

The Monetary Conditions Index (MCI)

Significance of the exchange rate for monetary policy

Monetary policy measures affect aggregate demand and prices not only through interest rates but also through exchange rates.[18] Furthermore, exogenous exchange rate movements influence the monetary policy setting. For a central bank in an open economy with flexible exchange rates and capital mobility, it is therefore advisable to include the exchange rate situation in the assessment of the underlying monetary conditions. This applies especially to small economies, in which the exchange rate has greater importance for economic developments.

Construction of the MCI

Given that background, the purpose of computing an MCI is to combine interest rate and exchange rate movements in a consistent manner and thus express the change in the underlying monetary conditions in a single variable. In its original form, as developed by the Bank of Canada, the MCI is, at a given time t, the weighted sum of the (relative) change in the effective real exchange rate and the (absolute) change in the short-term real rate of interest compared with a base period:[19]

$$MCI_t = w_e \cdot \left[\frac{\text{weighted real external value t}}{\text{weighted real external value in base period}} - 1\right]$$
$$+ w_r \cdot \left[\begin{array}{l}\text{short-term real rate of interest in t}\\ -\ \text{short-term real rate of interest in base period}\end{array}\right]$$

Interest rate movements are included in the MCI with a weight of w_r, and exchange rate movements are included with a weight of w_e.

16 Similarly, using the GDP deflator leads to striking deviations from the day-to-day money market rate in other periods, which do not occur when the consumer price index is used (at the end of the eighties and in 1997, for example).
17 Orphanides shows for the United States that using real-time data rather than revised data leads to significant differences in the Taylor interest rate. See Orphanides, A. (1998), Monetary policy rules based on real-time data, Finance and Economics Discussion Series 1998–03, Federal Reserve Board, Washington D.C.
18 In addition, a distinction can be made among a number of other transmission channels. See, for example, Mishkin, F.S. (1996), The channels of monetary transmission: lessons for monetary policy, NBER Working Paper No. 5464, Cambridge, MA.
19 See Freedman, C. (1994), The use of indicators and the monetary conditions index in Canada, in Baliño, T.J.T. and Cottarelli, C. (eds.), Frameworks for monetary stability – policy issues and country experiences, IMF, Washington, p. 470.

As a rule, these weights reflect the relative effects of the respective MCI component on aggregate demand. The effect on aggregate demand which is assigned to an increase in the short-term real rate of interest by 1 percentage point is the same as that ascribed to an increase in the external value of w_r/w_e per cent.

The base period, to which the MCI relates, is selected as desired. No independent significance is to be ascribed to the absolute level of the MCI. Its ongoing development can only indicate whether the underlying monetary conditions between two points in time have eased (decline in the MCI) or become tighter (increase in the MCI).

Use of the MCI as an operational reference variable ...

MCIs are used in quite a number of ways by various institutions. In the monetary policy of the Bank of Canada, which has been pursuing an inflation targeting strategy since 1991, the MCI is used as a short-term operational reference variable.[20] On the basis of the quarterly inflation forecasts, a "desired or target path for the monetary conditions" is determined internally which is compatible with the desired development of the inflation rate.[21] In the period between two inflation forecasts, there is a continuous examination of the direction in which the current MCI is moving and of whether there is cause for reassessing the price outlook and thus for adjusting the MCI path which is "consistent with the inflation target". If the monetary policy course appears to be in need of correction – which is signalled by a significant discrepancy between the actual MCI and the envisaged MCI – measures are taken to effect a change in the short-term interest rates.[22]

... and as a monetary policy indicator

Some central banks of smaller open economies (Sweden and Norway, for example), and especially international organisations, such as the IMF and OECD, and commercial banks use the MCI both as an indicator for a change in the degree of monetary policy restriction and as an indicator for future output and price developments.[23] In both cases, the analysis focuses primarily on the development of the current MCI, and not on a comparison with a "target path" for the MCI which is de-

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20 See, for example, Freedman, C. (1994), The use of indicators and the monetary conditions index in Canada, in Baliño, T. J. T. and Cottarelli, C. (eds.), Frameworks for monetary stability – policy issues and country experiences, IMF, Washington, pp. 458–476, and Freedman, C. (1995), The role of monetary conditions and the monetary conditions index in the conduct of policy, in Bank of Canada Review, autumn 1995, pp. 53–59. On account of the significantly more rapid availability of the necessary data, the Bank of Canada uses the nominal MCI as a basis for this, although the real MCI is, theoretically, the relevant variable. However, this poses few problems if the MCI is employed for the short-term analysis as the development of both variables is invariably very similar over short periods.
21 The path of the "desired MCI" is construed more as a range than as a precise line of development, however. See, for example, OECD (1998), Economic Surveys, Canada, p. 13 and p. 137.
22 In the last two years, the MCI played a role in the implementation of monetary policy at the Reserve Bank of New Zealand which was similar to that at the Bank of Canada. Latterly, however, its importance has been scaled down somewhat. See Reserve Bank of New Zealand (1996), Summary indicators of monetary conditions. Reserve Bank Bulletin 59/3, pp. 223–228, Reserve Bank of New Zealand (1996), Monetary Policy Statement, December, p. 22f.; Reserve Bank of New Zealand (1997), Monetary Policy Statement, June, p. 25ff.; Reserve Bank of New Zealand (1999), Monetary Policy Statement, March, in particular, p. 20f. and p. 27f., and Reserve Bank of New Zealand (1999), Reserve Bank Bulletin 62/1.
23 The IMF suggested the MCI as an inflation indicator to supplement M3 for Germany, for instance. See Corker, R. (1995), Indicators of monetary conditions, in Corker, R. et al., United Germany: The first five years – performance and policy issues, IMF Occasional Paper, No. 125, pp. 51–61. In the case of the above-mentioned central banks, the MCI has always played a secondary role and has recently been further downgraded in importance.

rived in line with the final monetary policy objective.

MCI fraught with problems

The indicator properties of MCI are debatable, however. Firstly, this is connected with the fact that it is not a clearly specified statistical variable. Instead, it is – much like the Taylor interest rate – a construction which allows a certain amount of freedom in its calculation. Furthermore, it is based on econometric estimations, the results of which are generally very sensitive with regard to the chosen specification. Secondly, movements in the MCI require a great deal of interpretation.

Selection of the MCI components

When constructing an MCI, the components to be included first have to be specified. The traditional MCI, i.e. the weighted sum of the changes in the real effective exchange rate and in the short-term real rate of interest, is by no means necessarily appropriate for every currency area. In particular, if it is construed as a yardstick of the influence which financial market prices have on the trends in real income and inflation, all the variables which are of particular relevance in the transmission process in an economy are, in principle, to be included. For countries in which long-term financing relationships play a major role, as they do, for example, in Germany, it would be logically consistent to include a long-term interest rate in addition to the short-term interest rate and the external value.[24]

Exact definition of the components

The exact definition of the components included in the MCI influences the computation of the indicator, too. The day-to-day money market rate or the three-month rate is normally used as the short-term interest rate. The expected inflation rate for the relevant period is deducted in order to calculate the real rate of interest. The expected inflation rate is generally approximated using the current rate of inflation, which may relate, in principle, to different price indices. Owing to the fact that the inflation rate develops quite slowly in the short term, approximating expected price movements by means of current ones appears generally acceptable for the short-term real rate of interest.[25] The choice of the deflator plays a crucial role in terms of the real external value. The deflator can be calculated, for example, on the basis of the prices for total sales, consumer prices, or unit labour costs. Since these series differ – in some cases significantly – in their development, the selection of the deflator has both a direct and – through the computation of relative weights of the MCI – an indirect influence on the movement of the MCI.[26]

Estimation of the relative weights fraught with a high degree of uncertainty

The relative weights with which the individual components are included in the MCI are not observable and must therefore be estimated econometrically. The MCI therefore depends on the specification and the assumptions of these estimations. In the majority of analyses, the weights are determined using single

24 An "extended" MCI is not a very suitable monetary policy indicator, however. To an even greater extent than the traditional MCI, it is subject to numerous different influencing factors which are independent of monetary policy.
25 By contrast, if a long-term interest rate is additionally used, this approach can, at times, be misleading. It is likely that the long-term ex post real rate of interest tends to be overestimated in periods when interest rates are very low and underestimated when inflation rates are high.
26 For alternative ways of measuring the real external value, see Deutsche Bundesbank, The indicator quality of different definitions of the real external value of the Deutsche Mark, Monthly Report, November 1998, pp. 39–52.

equation-estimates. From an econometric point of view, this has a number of shortcomings and thus increases the risk of inaccurate monetary policy assessments.[27]

Assumed transmission process disregards important transmission channels

The weights of the MCI components are generally estimated on the basis of real-income equations even if price stability is assumed as the final objective of monetary policy. This makes the implicit assumption that monetary policy influences the inflation rate only through the output gap. In this way, other transmission channels are disregarded. For example, movements in the exchange rate may have a direct impact on the consumer price index as a result of changes in import prices. Furthermore, the liquidity gap plays a significant role in explaining the development of inflation. An MCI with weights estimated on the basis of a real-income equation, is thus likely to be of limited usefulness, at most, for the inflation forecast.[28] In principle, this criticism could be met by estimating the MCI weights on the basis of "price equations" rather than of real-income equations.[29]

Need to interpret the MCI

Irrespective of the difficulties in constructing an MCI, there is the problem that it is by no means easy to interpret its changes in terms of their significance for current monetary policy. Whether it is appropriate or not for the central bank to take an interest rate measure in response to a change in the MCI caused by an appreciation or depreciation of the domestic exchange rate depends, in principle, on the reasons for the change in the exchange rate. If the change in the real exchange rate has its origins in the real economy – say, in an exogenous rise in foreign demand for domestic goods – it would not be at all appropriate, with a view to the objective of price stability, to try to use monetary policy to reduce the MCI to its original level. That is because the demand shock, taken in isolation, is accompanied by an increased inflationary pressure which justifies more restrictive underlying monetary conditions. Mechanistically adjusting official interest rates in response to exchange rate movements – as suggested by an overly simple interpretation of the MCI – would by no means be appropriate. In practice, a central bank is additionally faced with the problem of being unable to identify the factors underlying a movement in the exchange rate with adequate certainty, or of being able to do so only after a considerable period. This fundamentally argues against excessive actionism on the part of monetary policy.[30]

Constancy of weights doubtful

The usefulness of using an MCI is also called into question by the fact that the assumed

27 See, above all, Eika, K. et al. (1996), Hazards in implementing a monetary conditions index, Oxford Bulletin of Economics and Statistics, 58, pp. 765–790. The associated problems are explained in greater detail in the annex on p. 62. As an alternative to single-equation approaches, more or less comprehensively specified econometric multi-equation models are used in some cases.
28 Ultimately, this is an empirical question, however. For Germany, an MCI with weights estimated on the basis of a real-income equation has no significant lead over prices. See annex p. 63.
29 Experience has shown, however, that simple specifications produce implausible weightings.
30 This applies to an even greater extent to an MCI extended to include the long-term real rate of interest. The interpretation of movements in the long-term real rate of interest is subject to difficulties comparable to those encountered in the case of the real external value. Moreover, it is risky to take monetary policy countermeasures in the event of an increase in the long-term real rates of interest which is regarded as unjustified by the fundamentals. A step of that kind may lead to a rise in risk premiums and thus to a further increase in the long-term interest rate, especially in situations where there is a high level of uncertainty in the financial markets. It might not even be possible under such circumstances to steer the MCI in the desired direction.

consistency of the relative weights of the individual components is not convincing over time.[31] The impact of exchange rate movements on aggregate demand depends, for example, on the domestic economic agents' relative share of indebtedness in foreign currency. A significant change in this share is likely to have an impact on the MCI weights. Furthermore, it has to be borne in mind that exchange rate movements do not affect the individual sectors of the economy equally but, instead, tend to have the biggest effect on the export-oriented sectors. Accordingly, the impact that an appreciation or a depreciation of the domestic currency has on the outlook for prices will depend on the specific economic situation in the sector of traded goods.

An MCI for Germany

Past weights of real rate of interest and weighted real external value for Germany 3:1

A typical estimation of the MCI weights for Germany based on an equation for the change in the output gap over the period from the first quarter of 1975 to the fourth quarter of 1998 is (all variables with the exception of the interest rate are logarithms; t values in brackets)

$$\Delta_4 (y - y^*)_t = \underset{(6.14)}{0.65}\, \Delta_4 (y - y^*)_{t-1} + \underset{(2.96)}{0.50}\, \Delta_4 (y^a - y^{a*})_t$$
$$- \underset{(1.88)}{0.09}\, \Delta_4 r_{t-8} - \underset{(1.30)}{0.03}\, \Delta_4 e_{t-8} + u_t$$
$$\bar{R}^2 = 0.59 \quad LM(1) = 1.96\ (0.16) \quad LM(4) = 8.80\ (0.07)$$

The expression Δ_4 represents the fourth difference, i.e. $\Delta_4\, y_t = y_t - y_{t-4}$, y_t represents real GDP and y^*_t the real production potential. $\Delta_4\, (y - y^*)_t$ therefore states the change in the output gap from the previous year. y^a_t and y^{a*}_t represent the corresponding variables for industrial countries (excluding Germany). The estimation of the production potential for Germany is based on a production function. Because of the lack of adequate data, the production potential of the industrial countries is estimated by applying the Hodrick-Prescott filter to the real GDP. The real external value e_t is the weighted external value vis-à-vis 18 industrial countries, deflated by the price index of total sales. The real short-term rate of interest r_t is the day-to-day money market rate less the current inflation rate as measured by the consumer price index. LM(1) and LM(4) give the results of the LM tests for first-order and fourth-order autocorrelation, respectively. The values in brackets in this case give the relevant marginal significance levels. It follows from the estimation that:

$$MCI_t = 0.25\ (e_t - e_0) + 0.75\ (r_t - r_0).$$

The ratio of the weights of the real rate of interest to the weighted real external value is hence 3:1, i.e. the relative weight of the real external value amounts to 0.33.[32] The standard error of 0.29 does have to be borne in mind, however. This implies the very broad 95 % confidence interval of – 0.25 to 0.91, which also contains the value of zero. Standardising this MCI to the first quarter of 1990 produces the curve in the chart on page 59.

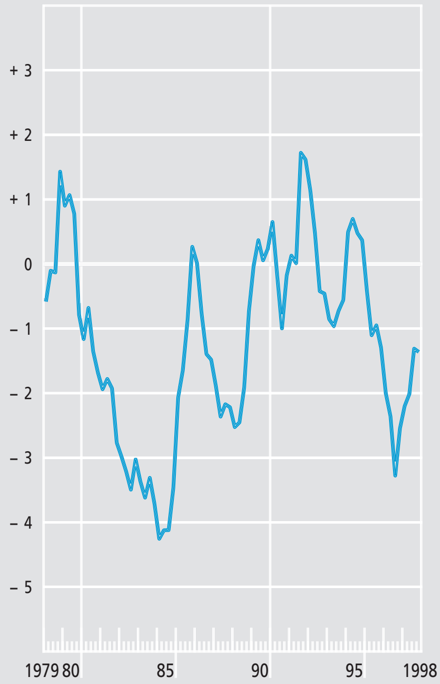
31 See also Smets, F. (1997), Financial asset prices and monetary policy: theory and evidence, Bank for International Settlements, Working Paper No. 47, Basle, p. 11.
32 In other MCI estimations for Germany, the weight of the short-term real rate of interest in relation to the real external value varies between 1.4 and 4. See, for example, Dornbusch, R. et al. (1998), Immediate challenges for the European Central Bank, Economic Policy 26, pp. 15–64; Frochen, P. (1996), Les indicateurs des conditions monétaires, Bulletin de la Banque de France, June, pp. 97–111.

Volatile curve of the MCI

This curve is characterised, firstly, by a fairly high degree of volatility. Secondly, it shows that the underlying monetary conditions – measured against the base period – were most restrictive in the early eighties and nineties, when inflationary pressures were quite high. Since the second half of 1992, there has been a marked easing of conditions as a result of the reduction in official interest rates, although this easing was obscured at times (notably in 1994–5 and at the start of 1998) by a real appreciation of the Deutsche Mark. In 1999 so far, there has been an obvious easing of the underlying monetary conditions due to a weakening of the euro exchange rate and the Governing Council of the ECB cutting interest rates in April.

MCI for Germany

1st qtr 1990 = 0, quarterly averages



Deutsche Bundesbank

Lead properties of the money stock, the Taylor interest rate and the MCI with regard to price movements

Investigation of the lead over price movements ...

Notwithstanding the indicated shortcomings of the Taylor interest rate and the MCI, the possibility that analysing them (as a supplement to M3) would have provided additional information for the Bundesbank's policy in the past cannot be ruled out a priori. That would have been the case especially if they had possessed a satisfactory predictive quality for price movements. The lead over price movements for the money stock M3, the Taylor interest rate and the MCI was therefore examined in greater depth. The relevant econometric estimations showed that the money stock had lead properties, but not the MCI and the Taylor interest rate.[33] This is also illustrated by the chart on the next page.

The upper panel of the chart shows the curve of the differential between the Taylor interest rate and the day-to-day money market rate, the curve of the MCI as it was previously calculated (but with a reversal of sign), and the "price gap" using the P-star approach, which reflects the pressure on prices indicated by the money stock. The rising curve of each indicator shows a monetary policy that is becoming more expansionary. Taken in isolation – with certain time lags – this ought to lead to rising rates of inflation. The lower part of the chart therefore shows the movement in the consumer price index.

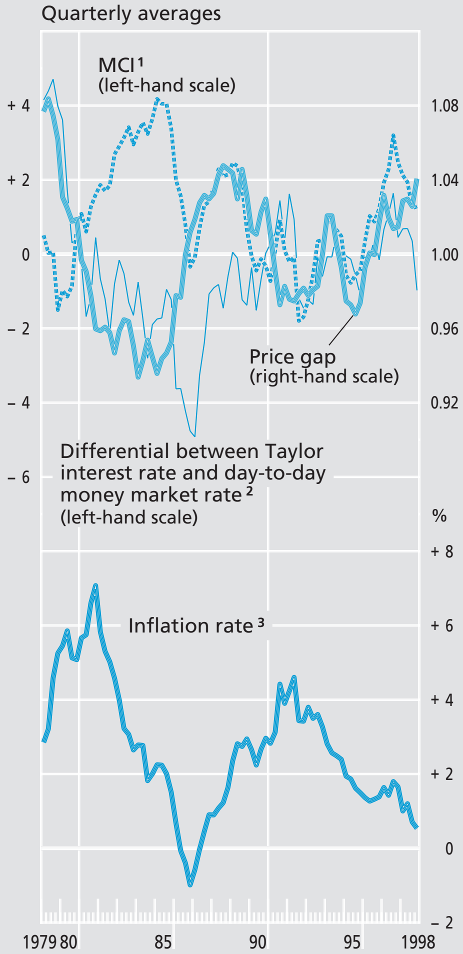
... reveals satisfactory results for M3, ...

It can be clearly seen that the money stock (in the form of the price gap) displays a lead over

33 See annex, p. 63.

MCI, Taylor interest rate, price gap and inflation rate

Quarterly averages



1 1st qtr 1990 = 0; reversal of sign. — 2 Day-to-day money market rate in Frankfurt; differential in percentage points. — 3 Percentage change from the previous year in the west German consumer price index.

Deutsche Bundesbank

price movements during most of the period under review. The "price gap" anticipates by between two and three years both the fall in the inflation rate from early 1982 to the end of 1986 and its subsequent rise up to 1992. The "price gap" turns out to be less reliable in the period after 1992, however, when the picture of monetary growth was frequently distorted, especially by changes in tax legislation.

... but not for the Taylor interest rate ...

The Taylor interest rate differential (at least up to around 1993) shows a movement that is largely parallel with inflation. A crucial factor is likely to have been the direct inclusion of the current inflation rate in the computation of the Taylor interest rate. Overall, the differential between the Taylor interest rate and the actual interest rate is not a satisfactory indicator of future price movements.

... and the MCI

The MCI's predictive quality for price movements is also unsatisfactory. The signals it gives for the period from early 1982 to the end of 1986, during which there was a continuous decline in inflation, are predominantly incorrect. In the period after that, its curve is very volatile – in contrast to the quite smooth development of inflation.

Monetary policy conclusion

Taylor interest rate and MCI to be used, at most, as broad reference variables

Both the Taylor interest rate and the MCI have significant shortcomings. How they are both calculated is subject to a large degree of freedom, and interpreting them is by no means as simple as it may appear at first sight. To that extent, they provide, at most, rough points of reference for the assessment of monetary policy.[34] Neither of the variables is hence suitable – applied in isolation – for deriving interest rate policy recommendations.

Monetary policy of the Eurosystem not based on the Taylor interest rate and MCI

The monetary policy strategy of the Eurosystem is based just as little on the Taylor interest rate and the MCI as was the former strategy of the Bundesbank.[35] Instead, the variables incorporated in them are examined individually. They are included in the broad analysis of the outlook for prices, which is the second pillar of the Eurosystem's monetary policy strategy alongside the reference value for the money stock M3. This takes account of the need to interpret the individual variables.[36] In particular, consideration is given to the fact that the monetary policy environment cannot be characterised solely by current price movements and the output gap or by the situation with regard to interest rates and the exchange rate. Instead, the broadly defined monetary aggregate M3 as well as a number of other monetary, financial and real economic indicators contain valuable information on the future trend in inflation. Ignoring these would not be appropriate for a central bank oriented to the objective of price stability.

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34 Taylor himself views the interest rate which is named after him more as a reference variable than as a rule which is to be followed mechanistically. See, for example, Taylor, J.B., The ECB and the Taylor rule. How monetary policy could unfold at Europe's new central bank, The International Economy 12/5 (1998), especially pp. 58–59. Likewise, the Bank of Canada fundamentally acknowledges the shortcomings of the MCI. It therefore stresses its specific use for short-term analysis, in which some of the mentioned shortcomings are less serious, as well as the necessity of thorough interpretation. See, for example, Freedman, C., The use of indicators and the monetary conditions index in Canada, in Baliño, T.J.T. and Cottarelli, C. (eds.), Frameworks for monetary stability – policy issues and country experiences, IMF, Washington D.C. (1994), pp. 458–476.
35 In any case, the MCI does not come into consideration as an operational variable for a large economic area with a comparatively low degree of openness.
36 The difficulties of computing the Taylor interest rate and the MCI are even greater for the euro area than for an individual country since the variables incorporated in them have to be aggregated from national data. As there are a number of possibilities of doing so, resulting in an additional freedom of scope in their computation, this leads to even greater variability in the calculated or estimated values. For the construction of an MCI for the euro area, see, for example, Verdelhan, A. (1998), Construction d'un indicateur des conditions monétaires pour la zone euro, Bulletin de la Banque de France, October, pp. 75–82.

Annex

Potential deficiencies of single-equation estimations for determining the MCI from an econometric point of view

Dynamics

The relationships between changes in the exchange rate or in interest rates and the change in the inflation rate or the rate of growth of real GDP are dynamic in nature. This means that their relative effects differ in the short, medium and long term, and perhaps even in terms of the direction in which the relationship works. Since prices react with comparatively long time lags, focusing on a time horizon of six to eight quarters (medium term) for analysis, as is usual when computing MCIs, is inadequate. Even if a given interest-exchange rate situation appears favourable with regard to price movements in the short-term perspective, the associated long-term trend may be undesirable from the point of view of economic policy.

Long-term properties

A consistent modelling of the long term is necessary even if the analysis is confined to a period of around two years. This assumes that the properties of the time series are adequately captured. If necessary, estimated or theoretical cointegration relationships have to be taken into consideration. Ignoring information of that kind leads to biases in the short and medium-term multipliers, from which the weights are derived.

Incorrect specification

Failure to include significant variables when the weights are derived affects the dynamics, the cointegration analysis, etc. Neglected variables lead to biases in the estimated parameters, i.e. in the relative weights. These biases may fluctuate over time.

Structural constancy

If conclusions are to be drawn on future price movements or the future growth of GDP, the weights must not change over time. However, unrestricted vector-autoregressive models and reduced form equations, in particular, often have widely varying coefficients if they are estimated recursively. One of the reasons for this is "over-parametrisation", i.e. the large number of parameters to be estimated.

Volatility clusters

The estimations for determining the weights are generally made using quarterly data. By contrast, for the current analysis daily data are included in the computation of the MCI, i.e. daily data are generated for this index. In the analysis of daily data in the financial market, however, model groups other than those for quarterly or annual data are appropriate, as the latter have different statistical properties (ARCH effects or volatility clusters). There is a risk of misinterpretation if these aspects are not taken into account.

What informative content do the MCI and the Taylor interest rate possess when compared with the price gap?

The question of whether the MCI has informative content for the future development of inflation which goes beyond that already contained in the price gap (and thus indirectly in the money stock) has not been given attention so far in the literature and will be discussed below.[37]

In logarithmic terms, the price gap equals:

$$(p^* - p) = (y - y^*) + (v^* - v),$$

where p^* is the equilibrium price level, p the current price level, y the real GDP, y^* the production potential, v^* the equilibrium velocity of circulation, and v the actual velocity of circulation. A positive price gap indicates inflationary pressure, i.e. a rise in the inflation rate in the future. The reasons for this are a high level of capacity utilisation (y-y^*) and/or a monetary overhang (v^*-v).

As the velocity of circulation for M3 shows a falling trend, this should be taken into consideration when calculating the equilibrium price level. The consumer price index is used to measure the price rise. The production potential is estimated using a production function.

The interaction between the short-term dynamics and the long-term equilibrium is depicted as an error correction model. The OLS estimation of the equation for the inflation rate gives:

$$\Delta_4 p_t = \underset{(64.94)}{0.97}\, \Delta_4 p_{t-1} + \underset{(7.60)}{0.09}\, \Delta_4 pim_t - \underset{(5.53)}{0.08}\, \Delta_4 pim_{t-1} + \underset{(2.70)}{0.03}\, (p^* - p)_{t-4} + u_t$$

The development of the inflation rate is influenced not only by the long-term effects, which are captured by the price gap, but also by short-term factors. Changes in import prices (pim) are therefore included in the equation above. The adjustment coefficient of the price gap is comparatively low. This implies a slow adjustment of the actual price level to the equilibrium level.

If the change in the traditionally defined MCI is included as well, the resulting coefficient is insignificant.

$$\Delta_4 p_t = \underset{(65.42)}{0.97}\, \Delta_4 p_{t-1} + \underset{(5.12)}{0.08}\, \Delta_4 pim_t - \underset{(5.15)}{0.07}\, \Delta_4 pim_{t-1} + \underset{(2.57)}{0.04}\, (p^* - p)_{t-4} - \underset{(1.05)}{0.04}\, \Delta_4 MCI_t + u_t$$

This indicates that the MCI has no explanatory power beyond the price gap for explaining the development of inflation. The likely reason for this is that the MCI is mainly a measure of the output gap.

An estimation incorporating the differential between the Taylor interest rate and the current interest rate shows that the differential likewise has no significant explanatory power for the development of the inflation rate.

37 For a description of the P-star approach, see Deutsche Bundesbank, The correlation between monetary growth and price movements in the Federal Republic of Germany, Monthly Report, January 1992, pp. 20-28.