A Discussion of the Taylor Rule

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Abstract

Monetary policy rules have been advocated as a mechanism to increase the transparency, accountability and consistency of the monetary policy decision-making process. These rules range from simple unconditional to more complicated feedback rules. In the case of the latter the policy instrument is determined by developments in underlying factors. The most prominent example of a feedback rule is the Taylor rule, which provides a simple estimate of the appropriate stance of monetary policy given an economy's inflation rate and the output gap. It can also be used ex-post in a descriptive capacity, providing an account of how a central bank has responded to economic developments in the past.

There is much debate as to how a Taylor rule should be operationalised. Amongst other things, this reflects issues over the data included, the use of interest rate smoothing techniques and the correct values that should be placed on the coefficients in the rule. Reflecting these issues different Taylor rules produced for an individual economy can provide very different policy prescriptions. As a result, they should be interpreted with caution. Bearing this in mind, however, the paper reviews the recent changes in monetary policy in the major economies relative to the Taylor rule.

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1. Introduction

There has been much debate about the usefulness of policy rules in the setting of monetary policy. A monetary policy rule places a restriction on the discretionary policy options that policymakers might be disposed to follow. As a result, such policy rules have been advocated as a mechanism to increase the transparency, accountability and consistency of monetary policy decisions. The second half of the twentieth century saw the development of important economic insights — the Lucas critique, rational expectations and the time inconsistency of policy — which considered the benefits of policymakers following such a rule. Various forms of rules have been suggested, ranging from simple unconditional rules — such as keeping the rate of money growth constant — to more complicated conditional or feedback rules. In the case of the latter, the policy instrument is determined by developments in underlying factors. The most prominent example of a feedback policy rule is the Taylor rule. Introduced by Stanford economist John Taylor in 1993, the rule has become extremely popular. It has both normative and descriptive functions. In regard to the former, it provides a simple measure of the appropriate stance of monetary policy, taking inflation and the output gap into account. In the case of the latter it can also be used ex-post to assess how a central bank has responded to these variables in the past.

The purpose of this article is to introduce the Taylor rule and outline some important issues related to it. It is intended to be informative and educational, but does not represent the views of any actual policy makers. The article is organised as follows: Section 2 takes a brief look at the development of monetary policy rules and provides a more detailed look at the Taylor rule itself. Section 3 focuses on three important issues related to the rule — data complications, interest rate smoothing and coefficient weightings. Section 4 illustrates Taylor rules recently produced by the International Monetary Fund and uses them to assess broad trends in monetary policy over the last decade. Finally Section 5 concludes. The article also includes a Box, which provides more information on the monetary policy 'rules versus discretion' debate.

2. Monetary policy rules and the Taylor rule

The concept of a monetary policy rule is not a modern idea. In their extensive survey of the subject, Asso et al. (2007) note that it was in the early nineteenth century that 'for the first time the importance of monetary policy being rule-guided acquired a great practical and institutional importance'. An early example of a monetary policy rule is the British gold standard, adopted in response to high inflation. In the first half of the twentieth century simple unconditional policy rules were favoured by many economists, the most prominent of which was proposed by Milton Friedman. Friedman advocated a monetary policy rule, the k% money growth rule, which aimed to keep the rate of monetary growth constant (outlined in detail in Friedman (1960)). This simple rule called for the monetary authority to avoid sharp swings in policy by adopting publicly the policy of achieving a steady rate of growth in a specified monetary aggregate. The rate of increase 'should be chosen so that on average it could be expected to correspond with a roughly stable long-run level of final product prices'. Given the long run historical trend, Friedman argued that a growth rate of 3 to 5 per cent per year would correspond with this objective.

As Box 1 outlines, it was not until the 1970s and 1980s that the benefits of a monetary policy rule were more fully developed. This was in response to the substantial rise in inflation during the 1970s. During this period the type of policy rule being proposed moved away from simple unconditional rules of Friedman's kind, with conditional or feedback rules increasingly favoured instead. In a feedback rule the policy instrument responds to changes in underlying economic variables such as the inflation rate and unemployment. An early example is a rule devised by McCallum (1987), who suggested that the monetary growth rate should be adjusted in response to changes in the velocity of the monetary base and the divergence of nominal GNP from a target path. In 1993 Stanford economist John Taylor introduced a

Box 1: Time inconsistency and the monetary policy 'rules versus discretion' debate

The twentieth century experienced a lively debate over whether monetary policy should be rules-based or discretionary. Prior to the 1970s there was a broad consensus that a discretionary policy was the better one, despite arguments in favour of policy rules advanced by Simons (1936) and Friedman (1960), amongst others. As Dwyer (1993) notes, there was a view during this period that 'discretion could be used to produce the same values of the policy instruments as would be feasible with any restriction'. However, during the 1970s the US economy experienced a period of sustained high inflation. This period, known as the Great Inflation, raised question marks over the ability of discretionary policy to keep price pressures in check, and led to a renewed interest in monetary policy rules. Against this backdrop, the view that a discretionary policy would always outperform a policy rule was challenged by the view that economic performance could be improved by committing to a policy rule.

This conclusion emerged from the seminal work of Kydland and Prescott (1977) on the so-called time inconsistency of economic policy. Kydland and Prescott showed that policies made on a discretionary basis were likely to result in a worse outcome than if policymakers committed to follow a policy rule. As the term suggests, time inconsistency occurs when policymakers are inconsistent in their decisions over different periods. Once it is assumed that private agents' expectations are made rationally, it is easy to see how this can occur. Given the key role that expectations play in determining behaviour it is in the interest of policymakers to commit in advance to a certain policy to control these expectations. In the case of monetary policy, for example, policymakers may announce that they intend to keep inflation low. When the time for policy action comes about, however, with expectations having already been set, it is feasible for policymakers to renege on the promised action and to take a different course. They may decide to create 'surprise inflation', for example, in order to boost employment and economic output. By lowering interest rates policymakers can move employment above its long run natural rate temporarily as workers consider increases in nominal wages to equate to increases in real wages.

However, such misperceptions will not continue as higher inflation erodes real incomes. Rational agents know that this incentive exists and so the initial monetary policy commitment may not be credible. Accordingly, inflation expectations — and future inflation — will increase. For example, wage earners will expect higher inflation and require higher wages to compensate for this. Businesses will, in turn, have to raise prices to keep their margins intact. Against this backdrop it is easy to see how a general inflationary environment could quickly emerge and strengthen. In a scenario where a policy rule meant that the initial commitment to low inflation was credible, by comparison, the outcome would be a lower inflation rate. The latter outcome is clearly superior to the first. There would be no difference in the unemployment rate between the two situations since there would be no surprise inflation.

This analysis, and further work by Barro and Gordon (1983) amongst others, highlighted the importance of credibility in policy making. The benefits of a rules-based framework and of independent central banks were two of the developments to emerge from this literature.

simple feedback rule, which has become very popular. The Taylor rule is a simple formula that can be used to assess how a central bank's interest rate should respond to changes in the inflation rate and activity levels, given the economy's inflation target and level of potential output. This normative function of the rule provides a simple assessment of the desirable path of interest rates given underlying developments. When introducing the rule, Taylor (1993) showed that deviations in these key economic variables from their target levels provided a 'remarkable' explanation for Federal Reserve policy decisions over the period 1987 to 1992. Hence, the rule can also be used ex-post in a descriptive capacity, providing an account of how a central bank has responded to economic developments in the past.

Taylor's original formula takes the form:

$$i = r + \pi^* + 1.5(\pi - \pi^*) + 0.5(y - y^*) \qquad (1)$$

where;

i is the interest rate suggested by the rule;
r is the equilibrium value of the natural real interest rate;
π^* is the central bank's inflation target;
π is the actual inflation rate;
y is the level of output, y^* is the potential level of output, and $y - y^*$ is the output gap.

The formula therefore, suggests that a central bank's policy rate should be determined by four factors:

- The natural real interest rate (r);
- The central bank's inflation target (π^*);
- The inflation rate (π);
- The deviation of output from its potential level (y — y*).

Taylor assumed that the Federal Reserve had an unofficial inflation target of 2 per cent ($\pi^* = 2$) and that the US natural real interest rate — the interest rate that is consistent with output being at its potential level and stationary inflation — was also 2 per cent ($r^* = 2$). Accordingly, the original Taylor rule assumed an equilibrium nominal interest rate of about 4 per cent for the US economy. The other two factors — the deviation of the inflation rate from its target and the divergence of output from its potential level — determine how the interest rate should adjust in the short term. If the inflation rate is above its target, or the output gap is positive, for example, the Taylor rule recommends that the policy rate should be set above its equilibrium rate. If, on the other hand, the inflation rate is below its target, or the output gap is negative, the Taylor rule recommends that the policy rate should be below its equilibrium value.

Taylor placed a higher coefficient on the deviation of inflation from its target (1.5) then on the deviation of output from its potential (0.5). This reflects the so called 'Taylor principle'; the coefficient on the deviation of inflation from its target should be greater than unity to ensure that real interest rates increase in response to higher inflation. If this coefficient were less than unity an increase in the inflation rate would lead to a higher nominal interest rate, but a lower real interest rate. Hence, it would not be effective in curbing demand and reducing inflation. A coefficient of 1.5 means that for every percentage point that the inflation rate is above its target, the Taylor rule suggests that the central bank should raise its nominal policy interest rate by 1.5 per cent, thus raising the real interest rate.

As McCallum (2000a) has noted, central banks are unlikely to follow a mechanical formula in setting monetary policy. So why has the Taylor rule remained so popular? Taylor himself acknowledged that 'operating monetary policy by mechanically following a policy rule is not practical' when introducing the rule in his 1993 paper. However, he suggested that his policy rule could be made operational in two ways. The first was for the Federal Reserve to use his rule as one of the many inputs analysed when deciding on the appropriate stance of monetary policy. The second was for policymakers to use the 'fundamental properties' of the rule to guide policy setting, rather than following the actual formula very precisely. The fundamental requirement of the Taylor rule is that interest rates should be increased when inflationary pressures are rising and economic growth is

above potential, and should be decreased when inflationary pressures are diminishing and economic growth falls below potential. As Taylor put it 'this characterisation gives only the signs of the response coefficients of the policy rule. Rather than specifying the magnitudes of the coefficients, it states that the magnitudes should depend on the sensitivity of aggregate demand to interest rates'. Outside of policymakers, amongst analysts and commentators, much of the Taylor rule's popularity comes from its simplicity, which appears to make the measurement of whether monetary policy is too tight or too loose a relatively straightforward exercise.

3. Some issues related to the Taylor rule

3.1 Data issues and the Taylor rule

As noted in Section 2, the Taylor rule provides a relatively straightforward method of estimating the appropriate stance of monetary policy. However, a number of data issues exist which complicate the rule's construction somewhat and raise uncertainties. One of these is the significant degree of judgement that is required when producing a Taylor rule. Two of the variables in Equation (1) are unobservable and a number of alternative techniques can be used to calculate them. This can result in a range of different estimates of the variables at any one time. A 2006 ECB Monthly Bulletin Article on monetary policy activism highlights the potential divergence in Taylor rule measurements that this can cause. It presents a range of Taylor rules using different statistical measures. Between 1999 and mid-2006 the range of the required short-term policy rate based on these indicators spans from 50 basis points to 400 basis points at its widest.

The first of the unobservable variables is the natural real interest rate. A common approach used to proxy its value is to calculate its long-run historical value based on the ex-post difference between nominal interest rates and realised inflation, and this is the path followed by Taylor in his original work. Other approaches involve using some statistical methods or a structural model to ascertain its value.

The second unobserved variable in Equation (1) is the output gap. A sizeable literature exists regarding the measurement of the output gap, including whether it should be estimated from a structural model or using a more mechanical method such as statistical filters. Orphanides and van Norden (1999) note that the reliability of output gap estimates in real time tends to be quite low and using different methods to calculate output gaps can generate estimates that differ markedly in both number and sign. They find that the most significant factor behind ex-post revisions of output gaps is not the revision of published data, but rather the extra information that the subsequent evolution of the economy provides about the current position in the business cycle.

Caution is recommended by some commentators as regards the nature of the estimated data that is used in the calculation of a Taylor rule. Orphanides (1998) notes that, when policy rules are used to analyse historical decision-making, they often ignore the potential for subsequent heavy revisions. Measures of the output gap are particularly prone to such revisions. Using the Taylor rule, Orphanides finds that an assessment of policy recommendations for the US economy during the downturn in the 1970s differs considerably depending on whether real time data or ex-post revised data are used. More specifically, policymakers believed that US potential output was much stronger in the 1970s than actually turned out to be the case. Nelson (2001) finds that a similar overstatement appears to have occurred in the UK in the 1970s. This suggests that an inadequate concern for inflation may not have been as significant a cause of the Great Inflation as is often suggested. Orphanides et al (1999) confirm the significant impact of measurement errors and conclude that 'successful monetary policy design needs to be founded on realistic informational assumptions about what policymakers can and do know when policy decisions are being made'.

A further data issue relates to the use of forward-looking data. The original Taylor rule used a contemporaneous measure of inflation in its construction. It is now commonly

accepted, however, that a change in interest rates today will not affect the current rate of inflation, but rather the rate in the future. In other words, monetary policy operates with a lag, and the maximum effect is felt typically more than a year after the policy change. This explains the medium-term outlook of most central banks. Accordingly, a monetary authority is likely to use forecasts of inflation rather than the current actual inflation rate when setting the appropriate policy rate and the Taylor rule should incorporate such a measure of expected inflation in its calculation. This entails a third unobservable variable in Equation (1). Batini and Haldane (1998) highlight the benefits of incorporating forward-looking data in policy rules; such rules better control for the effects of monetary transmission lags and ensure that policy is responsive to the most timely information, features that allow better inflation and output control. Work by Clarida, Gali and Gertler (1997, 1999), amongst others, estimate forward-looking monetary policy reaction functions for many of the G7 countries. In a euro area context, a recent paper by Gorter, Jacobs and de Haan (2007) concludes that the ECB takes expected inflation into account when setting interest rates. They find that the coefficient on inflation is greater than unity — obeying the Taylor principle — when forward looking data is used, consistent with the ECB's goal of price stability.

3.2 Interest rate smoothing

Another important issue highlighted by the literature is interest rate smoothing; the process where central banks adjust their policy rate in an incremental manner towards their desired level as opposed to adjusting the rate in one large movement. Brainard (1967) was the first to urge caution in policymaking, highlighting the uncertainties that exist. Subsequent literature has focused on whether central banks smooth interest rates and why they might chose to do so. Peersman and Smets (1998), amongst many others, suggest that central banks do smooth interest rates and only gradually move towards the policy rate suggested by a Taylor rule. Coupled with adequate communication, such a measured path avoids a sudden large interest rate shock and hence the interest rate path is better understood. Given the uncertainty regarding data timeliness, interest rate smoothing may be preferable to larger single rate adjustments as it allows the central bank to learn as it adjusts and to observe the reaction of the private sector to its adjustments. Woodford (1999) shows that inertial policy, or gradual adjustment, can be optimal as small but persistent changes in short-term interest rates in response to shocks allow a larger effect of monetary policy on long term interest rates and hence upon aggregate demand, for a given degree of overall interest rate variability. Rudebusch (2002, 2005) offers a contrasting explanation, however, suggesting that smoothing does not take place and that the illusion of such inertia may in fact reflect spuriously omitted persistent influences on policy. Rudebusch's arguments are, however, questioned by Castelnuovo (2003) who believes that interest rate smoothing is observable on the basis of the robustness of his findings across different specifications of the Taylor rule.

3.3 Empirical estimates of central banks' coefficient weights

Estimated Taylor rules seek to characterise how central banks historically changed policy rates in response to inflation developments and output gaps. The results of such analyses show that the way in which central banks conduct monetary policy can differ markedly across countries and regimes. A key feature of this area of the literature is ascertaining whether central banks, whether deliberately or inadvertently, adhered to the Taylor principle; is the co-efficient on the inflation variable in the Taylor rule greater than unity? As noted in Section 2 this ensures that real interest rates increase as required in response to higher expected inflation relative to the target.

With respect to US monetary policy, Clarida, Gali and Gertler (1999) find that the Fed has responded differently to deviations of inflation from its target, depending on the time period examined. In particular, they find the estimated value for the inflation co-efficient is below unity for the pre-Volcker period — when inflation was high — and far greater than one for the Volcker-Greenspan period up to the mid-1990s. Hence, during the 1970s the Fed violated the

so-called Taylor principle. The authors argue that this contributed to the inability of the Fed to combat the Great Inflation of the 1970s. A similar result is given by Hetzel (2000), who notes that the FOMC has done a better job since 1980 of controlling inflation because it became more aggressive in responding to realised inflation. Complementary work by Judd and Rudebusch (1998) finds that the Fed Funds rate during the Greenspan era appears to have reacted about twice as strongly to the output gap as Taylor assumed and it appears to have moved gradually, rather than instantaneously, into rough accord with the Taylor rule.

A somewhat contrasting picture is given by Orphanides (2003), who suggests that policies pursued during the Great Inflation do not appear to be obviously flawed; rather policymakers were responding to inaccurate real time estimates of the output gap. While subsequent revisions to the data might now show that the economy was overheated at the time, when actual policy decisions were being made such overheating was not clear. Indeed, Orphanides finds that Federal Reserve policy appears to have responded strongly to inflation forecasts over the period. He contends that this contrasts sharply with other work (such as Clarida et al above) that suggests that Fed policymakers responded to inflation insufficiently strongly for economic stability during the Great Inflation.

Some studies focus on cross-country comparisons of monetary policy reactions, including Clarida, Gali and Gertler (1997) who report estimates of monetary policy reaction functions for two sets of countries: the G3 (Germany, Japan and US) and the E3 (UK, France and Italy). They find that since 1979 each of the G3 central banks pursued a monetary policy strategy that adhered to the Taylor principle. The primary driver of monetary policy changes in those countries appears to have been in response to inflation developments with rates adjusting to the output gap by a small amount. The reaction to changes in inflation is lower for the E3 countries than the G3 countries, by comparison. Work by McCallum (2000b) compares alternative monetary policy rules across the US, UK and Japan. For the US, all of McCallum's rules would have called for tighter monetary policy during the 1970s, again suggesting that the policy rate was set too low and that the Taylor principle was not adhered to. For the UK, the various rules suggest the monetary policy was much too loose in the 1970s, but there is some disagreement with regard to later years; the monetary base-instrument rules suggest that policy was also too loose during the middle and late 1980s whereas the interest-instrument rule does not. Finally in Japan most of the examined rules indicate that policy was too tight in 1998, but the monetary base rules suggest excessive tightness for the entire period 1990-1998, while the interest rate rules do not.

Focusing on the euro area, adherence to the Taylor principle is identified in work by Gerdesmeier, Mongelli and Roffia (2007) and Gorter, Jacobs and de Haan (2007). The former estimate a standard Taylor rule with interest rate smoothing for the euro area, the US and Japan, using a three-month interest rate. They find that the euro area is the only economy where the Taylor principle has been fulfilled since 1993. Sauer and Sturm (2003), by comparison, find that while the ECB's inflation coefficient is greater than the output coefficient it does not exceed one. In other words, the ECB moves in response to changes in inflation but does not increase nominal rates sufficiently to keep the real interest rate from declining. It should be noted, however, that the sample period in this study is somewhat narrow, given the ECB had been setting policy rates for less than four-years when the paper was published.

Finally, the Taylor rule has been criticised for being too simplistic a measure, as it does not encapsulate all of the relevant information needed to conduct monetary policy in its two variables, inflation and the output gap. Central banks may have other objectives, such as the maintenance of financial stability or an exchange rate objective, which are not encapsulated by specific variables in the Taylor rule. Alternative variables have been included in some augmented Taylor rules to try to enhance the information properties of the rule

to better reflect the broader considerations of central banks. These include the addition of other production or monetary variables to try to encapsulate a fuller analysis.

For example, Gerdesmeier, Mongelli and Roffia (2007) estimate a specification of the Taylor rule for the euro area where a monetary variable is added, as per the two-pillar strategy. This continues to exhibit the presence of the Taylor principle, yet the result for the monetary term is surprisingly negative. Gerlach-Kristen (2003) presents an alternative reaction function using a cointegration approach and, in contrast to the traditional Taylor rule, finds a significant role for the long rate. The author's results also support the adherence to the Taylor principle in the euro area, given that the coefficient on the inflation variable is greater than one. It is possible, however, to argue that this approach of including additional variables in a Taylor rule is unnecessarily complex without adding value. For example, monetary aggregates might provide additional information about prospective inflation, but this should really be already factored into forecasts of inflation. Similarly, financial stability concerns should also be factored into the forecast. At the moment, for example, the impact of the financial market crisis is being encapsulated in lower growth forecasts.

4 Taylor rules in practice

It may be useful to illustrate simple Taylor rules for the US and euro area economies. In this section we focus on what these Taylor rules tell us about monetary policy over the last decade, and in particular about the response of the ECB and the Federal Reserve to the financial market turmoil and subsequent sharp downturn in global economic activity.

4.1 Taylor rules for the US and the euro area

Charts 1 and 2 illustrate Taylor rules for the US and euro area economies for the years 2000 to 2009 along with the actual policy rates for each economy over this period[1]. These rules were produced by the International Monetary Fund (IMF) for April's World Economic Outlook[2]. With regard to the data inputs, the natural real rate of interest is a function of potential output growth and varies over time as potential output changes. The output gap is computed using a model-based approach, rather than a statistical filter, and one-year ahead consensus forecasts provide a measure of expected inflation. As the rules are produced for a number of advanced economies under a uniform methodology, they allow for a direct cross-country comparison of the policy stance.

Before taking a closer look at the Taylor rules, it is important to emphasise once again the significant amount of judgement that is required in their construction. As noted in the preceding section, three of the inputs — the natural real interest rate, the output gap and expected inflation — are unobservable, and various methodologies can be used to estimate their values. There is also debate about the values that should be placed on the coefficients in Equation (1). As we have seen, these factors can result in Taylor rules for individual countries varying considerably and provides one of the reasons why using a formula to mechanically set policy is generally seen by policymakers as inappropriate. Reflecting this uncertainty one should not focus on specific point estimates when analysing a Taylor rule, but rather use the rule to determine broad trends. Based on the IMF's Taylor rules there are two such broad trends. The first of these is that policy rates were lower than the level suggested by the Taylor rule for a period during the decade. The second broad trend is that the response of the ECB and Federal Reserve to the financial market turmoil and subsequent economic downturn has been appropriate when seen through the lens of the Taylor rule.

[1] The observation period in the charts is quarterly; the policy rate for each quarter is computed by averaging the monthly policy rates.
[2] The IMF does not directly illustrate its Taylor rule, but publishes the deviation of the rule from the actual policy rate. As a result, computing the Fund's implicit rule is a straightforward exercise.

Chart 1: Taylor Rule for the US Economy

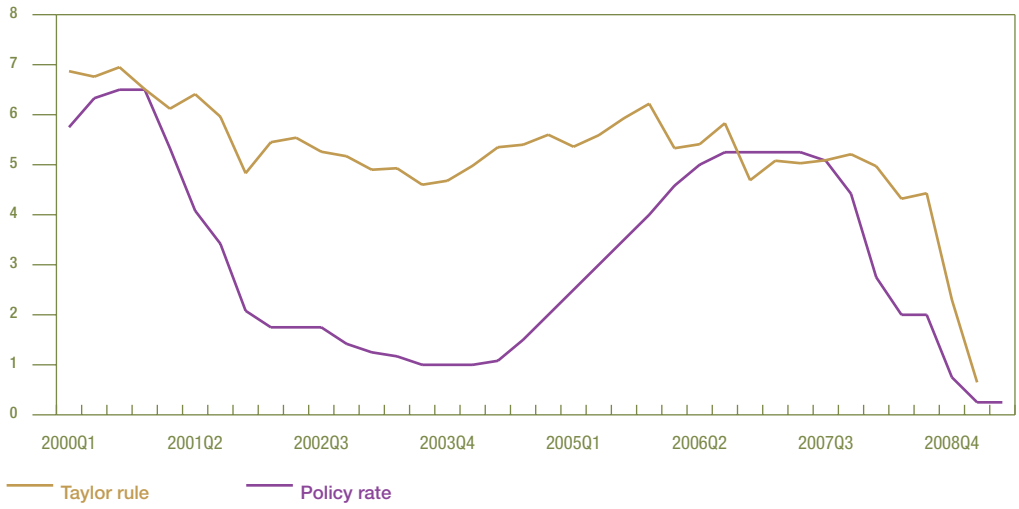


Chart 2: Taylor Rule for the Euro Area



The first of these trends receives support from a number of other published Taylor rules. In the case of the US, former St Louis Federal Reserve President William Poole (2007) and Taylor (2009) find that policy rates were below those suggested by a Taylor rule during the period mid-2002 to mid-2005 (although the gap between the Taylor and policy rates in these studies is narrower than the one illustrated in Chart 1). Taylor suggests that the divergence over this period provides an empirical confirmation that monetary policy was too lax between the years 2002 and 2005. He argues that the resulting availability of cheap credit was a factor in accelerating the US housing boom and, accordingly, one of the early causal factors behind the recent financial turmoil. For the euro area, as mentioned in Section 3.1, an article in the November 2006 ECB Monthly Bulletin presents a range of Taylor rule estimates using different statistical measures. While this highlights the potential divergence in Taylor rule measures, the actual policy rate was below the mean of this range — and also below the lower bound of the range — for much of the period mid-2003 to mid-2005. Noyer (2007) and Commerzbank (2007) also find that a gap emerged between their Taylor rule estimates and the policy rate in the middle of the decade, although the gap is much

smaller than in the case of the US. Both the ECB article and Noyer stress, however, that simple Taylor rules do not adequately take account of the ECB's two-pillar strategy. It is also important to note that the monetary policy stance may reflect risk factors that do not impact on economic projections but are significant enough to take note of. These factors could include concerns about deflation, financial stability and the geopolitical outlook, all relevant factors early in the current decade.

Turning to the second broad trend, the IMF's Taylor rules suggest that, while they have been somewhat different with respect to their initial timing, the response of the ECB and Federal Reserve to the global downturn has been entirely appropriate. The initial difference reflected the fact that the financial turmoil had a much stronger impact on the US economy — where it originated and where a sharp adjustment in the housing market was already taking place — at the outset. By comparison, it took somewhat longer for the turmoil to impact on real variables in the euro area and the rest of the global economy. Since the impact has spread and the global outlook has deteriorated sharply, however, the ECB has cut its key policy rate significantly. By June 2009 this main refinancing rate had been reduced by a cumulative 325 basis points and was at a historical low of 1 per cent.

4.2 The zero bound and non-conventional monetary policy

An issue that is particularly relevant in the current environment, where central banks globally have reduced policy rates to very low levels, is the existence of a lower bound on nominal interest rates, and the potential for a liquidity trap to emerge[3]. From Equation (1) we can see that in an extremely bad economic downturn the Taylor rule could be consistent with nominal interest rates lower than zero. In fact Rudebusch (2009) notes that recent FOMC forecasts suggest that the US policy rate should be negative this year. Against such a backdrop, how should a central bank respond? Mankiw (2009) and Buiter (2009) suggest that moving the nominal interest rate into negative territory is possible. However, doing so would require central banks taking extraordinary actions raising question marks over its practicality. Accordingly, as policy rates have moved closer to the lower bound in the current downturn, central banks have focused on non-conventional monetary policies to provide extra stimulus. Bini Smaghi (2009) defines these non-conventional policies as 'those policies that directly target the cost and availability of external finance to banks, households and non financial corporations'. In the current episode they have ranged from the provision of extra liquidity and expanding eligible collateral to the direct purchase of commercial paper, commercial bonds and asset backed securities.

[3] The latter occurs when the liquidity in the market that has been created by very low policy rates does not stimulate the economy sufficiently; developments in the Japanese economy in the 1990s provide an example of a liquidity trap in operation.

5. Conclusions

Monetary policy rules have been employed since the nineteenth century, but gained in prominence in the late twentieth century as the benefits of adopting a credible policy were fully established. Over this period the type of policy rule proposed has moved from simple unconditional rules — such as Friedman's k per cent money growth rule — to conditional or feedback policy rules. With the latter, the policy instrument responds to changes in underlying economic variables such as the inflation rate and unemployment. The Taylor rule is an example of a feedback monetary policy rule that has become popular.

The Taylor rule can be used in a forward looking mode — to assess the appropriate stance of monetary policy — or in a backward looking descriptive capacity to analyse past policy decisions. With regard to the former, given the significant level of judgement that is involved in selecting the underlying components of the Taylor rule, it clearly should not be followed mechanically by policymakers. Nevertheless, it can provide useful information and accordingly can be used as one of the many indicators analysed when a central bank is setting policy rates. With regard to historical policy developments, one should not focus on specific point estimates when analysing a Taylor rule, but rather use the rule to determine broad observations. Over the past decade

there would appear to be two of these. The first is that global interest rates may have been too low for a period in the middle of the decade, particularly in the US. The second is that central banks have responded aggressively to the current economic downturn, a development that Taylor rules suggest is appropriate. These results should be interpreted with caution, however. This not only reflects the judgement issue outlined above, but also the failure of mechanical policy rules to fully take account of a central bank's monetary policy strategy and risk factors that may surround economic projections.

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