Group Dynamics at the Bank of England (1997-2006)

Hawks and Doves Observed through Individual Reaction Functions

Rapport de recherche soumis en vue de l'obtention du grade de
M. Sc. en Sciences Économiques

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Mai 2007

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Abstract

Since it gained independence from the government in 1997, the Bank of England (the Bank) has faced important changes in the design of its monetary policy. In this paper, I focus on the impact of the creation of the Monetary Policy Committee (MPC), a committee of 9 members mandated to make decisions on the adjustment of the interest rate on a monthly basis. Thanks to improved transparency measures, minutes and votes on the interest rate have been available publicly, which has led the British press to go as far as ranking members from dovish to hawkish. Does a significant divergence in members' behaviors really exist? If so, can the votes be explained by dissimilar individual backgrounds or positions in the committee? This is the question I address by constructing individual reaction functions based on macroeconomic variables.

Following the literature on Taylor-type rules, I pool individual decisions at each period and I estimate responses to output and inflation gaps from August 1997 to July 2006. Since it is interesting to measure differences between group's behaviors, I cluster the individuals by their position in the committee, namely as either inside or outside the Bank and perform series of tests on the explanatory variables. Even though estimations with the level of interest rate as the dependent variable are informative, it remains that the decision is taken with respect to the preceding month interest rate. In this case, where the dependent variable is in first-differences, ordered probit is a more appropriate method of estimation. Hence, it appears that internal members vote with a certain bias towards higher interest rates, but further tests cannot attribute this result to different coefficients for the inflation gap or the economic activity indicators. I repeat the same procedure clustering MPC members according to their most important career position, namely at the Bank itself, in academia or in the private sector. Here, the results suggest that former or current academics react differently by giving a greater weight on the output gap than members with different backgrounds. The robustness of this result is supported by the estimation of the reaction function with forward-looking explanatory variables.

Keywords: Monetary Policy Committee, voting, individual reaction functions, Taylor rule

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[§] I would like to thank my supervisor: Francisco Ruge-Murcia for many advices during this project. I am grateful to James Mitchell at the National Institute of Economic and Social Research for providing me data on monthly GDP. Special thanks also go to Jean-François Bélisle and Laura O'Laughlin for helpful comments and to Maximiliano Cacace for programming assistance.
All estimations and statistical manipulations have been performed in STATA 9.2

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I. Introduction

"For some time now, I have been arguing that central banks should judge their success by how boring they are."

Mervyn King (2001), Governor of the Bank of England (2004-present)

The preceding quote effectively represents the objectives policy-makers have in mind where credibility is concerned: monetary policy should be predictable, almost boring. However, looking on the institutional side, changes that occurred in the past years have made monetary policy anything but boring to analyze. The United Kingdom entered a new era on May 6th, 1997 when its chancellor of exchequer, Gordon Brown, announced the operational independence of the Bank of England. Freed from political cycles, the Bank's independence has also dragged other types of changes classified into three other trends identified by Blinder and Wyplosz (2005) such as transparency, inflation targeting and decisions by committee. These concepts are hardly separable; however, in this paper, I will focus on the last one.

As most industrialized countries' central banks rely on a committee to conduct their monetary policy, it is interesting to study the interactions and power struggles inside the Monetary Policy Committee (MPC), the committee charged with this task in the United Kingdom. The Bank of England publishes many statistics including the individual member votes at each of its meetings. Therefore, it is possible to observe the divergence in points of view in a quantitative manner. According to the classification of Blinder (2006), the MPC stands as one of the most democratic central banks. Its structure is defined as *individualistic* where members' votes all have the same weight and where the adopted interest rate is the one favored by a majority of members. Its composition is also rather heterogeneous (one Governor, 4 internals and 4 externals), thus group dynamics may take a considerable place in the analysis of the decisions. In order to compare the decisions, the analysis implies the construction of individual reaction functions based on macroeconomic variables.

In the literature, a whole branch focuses on the minimization of a loss function[1] that generally includes two key variables: output and inflation, in order to describe the central bank actions. The analysis of monetary aggregates and the LM curve have been slowly left behind in the literature[2]. In fact, central banks also questioned the usefulness of monetary aggregates as instruments. Alan Blinder (1998), a former member of the FOMC, considered that: ferocious instabilities in estimated LM curves in the United States, United Kingdom and many other countries, beginning in the 1970s and continuing to the present day, led economists and policymakers alike to conclude that money-supply targeting is simply not a viable option. The interest rate targeting rule has thus benefited from greater concerns on monetary policy instruments. In fact, the pioneer work of Taylor (1993) has been popularized to many countries and periods. In his paper, "Discretion versus policy rules in practice", the author proposed a simple rule where the interest rate responds positively both to output and inflation gaps. In this vein, research has been conducted on forward-looking considerations or gradualism in the interest rates in order to increase the explicative power of the rule.

After having pooled the members' decisions, tests are conducted in order to point out discrepancies in behaviors that would be related to the member's status in the committee (internal or external). Estimations lead us to conclude that external members are more likely to choose a looser policy than their counterparts. However, the estimated weights given to the inflation gap or to the output gap do not seem to differ significantly. In the second step, members are clustered according to their professional experience in a certain field: whether it would be academia, the Bank itself or the private sector. Results show that members with academic background tend to assign a larger weight to the output gap. In fact, decision-making by committee generates an additional dimension to the interest rate's behavior that would give additional importance to the identification of the sources of divergence.

[1] Clarida, Gali and Gertler (1999) derive the interest rate from a policy objective of the central bank Woodford and Giannoni (2002) in the task to determine optimal monetary use generalized forms of the Taylor rule and loss functions

[2] Romer (2000) presents a New-Keynesian framework that encompasses an interest rate targeting rule.

The paper is structured as follows. Section II focuses on the impacts and sources of the institutional reforms that showed greater transparency through a committee structure. In order to introduce an individual reaction function for the MPC members, I examine in Section III the literature that has its foundations in the Taylor rule. I also examine developments that have been built on forward-looking aspects and on the inertial behavior of the interest rates. Section IV gives a short description of the variables used and their transformations. In section V, I estimate the reaction function with contemporaneous pooled data. First, I estimate monthly interest rates in levels by OLS regression with robust standard deviations. Second, since monthly decisions consist of increases or decreases of multiples of 25 basis points, the estimation of the interest rates in first-differences is performed by ordered probit. In section VI, I introduce forward-looking considerations, substituting the contemporaneous value of the inflation gap by projections at different horizons. Finally, section VII summarizes the main results and concludes.

II. Institutional developments

"Some central banks also set out formally how they think about the links between interest rates, inflation and other economic variables. Some also explain their policies at regular press conferences." The Oracle becomes less Oracular, *The Economist*, November 30th 2006

Nowadays, accountability and transparency measures are at the center of the Bank of England's concerns. In the perspective of making a large amount of information available publicly, communication plays a decisive role in order for financial markets and economic agents to really grasp the Bank's actions. According to Geraats (2006), it has achieved an impressive degree of openness to information with the publication of minutes and voting records. Moreover, in order for the public clearly understand the Bank's position toward the inflation target, for instance, it has devoted a whole branch in charge of educative purposes. The publication of output growth and inflation forecasts has also

contributed to a certain consistency in the Bank's actions and has elevated its reputation. In fact, Gerlach-Kristen (2004) reports the impacts of the availability of voting records on financial markets. The author concludes that financial markets react to this kind of information. For instance, if three members out of nine would have preferred a decrease at a given period, it is likely that the markets would adjust their expectations toward a decrease for the subsequent period.

Reforms have also brought changes in the decisional structure of the MPC assigning equal power to nine members (5 internal to the Bank and 4 external) in the final decision. Since it is a majority decision, Blinder (2006) classifies this type of committee as *individualistic*. Even though this structure suggests that power is divided equally, there are some institutional features that may distort this view. In fact, members of the committee are appointed by the chancellor of exchequer for a term period that depends of their position: three years renewable for the four external members and the two appointed members from the Bank and five years for the Governor and for the two deputy governors. Moreover and most significantly, since the Governor's decision precedes the votes of other members, it can thus be considered as a proposal that holds additional power.

Experimental economics through the work of Blinder and Morgan (2005) have played an important role in measuring the consequences of this heterogeneity. The authors show that monetary policy conducted by a committee benefits from differences in point of views and carries out better and less volatile decisions than ones that would have been taken by a sole central banker. Heterogeneity's benefits have also been assessed in a study of Lombardelli et al. (2004). One of the findings is that individuals learn from each others' decisions through time. Finally, authors agree that an *individualistic* structure, such as the MPC, gains from a large number of positions and tends to eliminate any extreme decisions. However, the communication exercise to the public would have to be clear and coherent in order to avoid distorted signals.

The issue of decision-making by committees has also benefited from game theory in the examination of the importance of reputation. Sibert (2003) introduced a model of two different types of policymakers: an *opportunistic* type that achieves his goals by letting inflation raise and a *zero inflation* type that reacts mechanically to the presence of inflation. In a committee structure, a member should take into account in his vote the potential decisions of the other members which may create incentives to lag a certain action if its impact on the final chosen interest rate would be minimal. Riboni and Ruge-Murcia (2006) model the decision-making process by including some costs to the decision such as the effects on their bargaining power in future states of disagreement. According to the authors, adding elements of heterogeneity in the members' decisions and giving more weight to the Governor's position would help explain the inertia in the interest rates by institutional features. The analysis of individual reaction functions is thus a complex task that requires an understanding of the group dynamics.

On empirical grounds, Chappell et al. (2004) based their historical analysis of the FOMC's monetary policy on an individual basis. Political influences on members' votes are examined with a bivariate probit model for different eras of chairmen. The first step consists to take the adjusted values from a regression of the interest rate on many conjuncture variables estimated by OLS. Thereafter, in order to account for dissension vis-à-vis a tighter or looser policy, an ordered probit is performed which allows different intercepts for all members. Finally, it is possible to test if the allegiance to the Democratic or Republican Party has a significant effect on monetary policy. Historically, it might have had an impact on the Fed's conduct of monetary policy. However, since our study of the MPC leans toward a recent period of independence under the governance of only one party, Labor, it is rather the methodological approach brought up by Chappell et al. (2004) than the political impacts that has been interesting for our analysis.

As for the analysis of group dynamics at the MPC, Spencer (2006a, 2006b) provide interesting results in the literature on individual reaction functions. In the first paper, dissenting votes for increases or decreases in the interest rates are the dependent variable in a model where decisions are pooled. From a monthly sample extending from

June 1997 to June 2003, an individual reaction function with economic activity indicators as explanatory variables is estimated by ordered logit. Many type of rules are estimated and it appears that external members prefer to dissent for lower interest rates when compared to internal members. In his second paper, Spencer (2006b), convinced that searching for differences between individuals in their adherence to either the monetarist's or Keynesian's current is an artifact of a bygone era, looks for causes of dissension elsewhere. In fact, the members' career backgrounds differ, since they could have had some experience at the Bank itself, in the private sector, in an NGO, in the government and in academia. A regression (OLS) of dissenting individual votes on the number of years for each member spent in each sector is performed. Results are not conclusive in this case and allowing intercepts to differ for the member's status in the committee leads once again to the finding that internal members prefer a tighter monetary policy. After having examined the possible sources of dissension in the MPC, the next step would be to identify variables to include in the reaction function by keeping its form as parsimonious as possible.

III. Reaction functions and the Taylor Rule

Institutional developments in central banks have also coincided with a different theoretical approach to monetary policy. Due to the increasing volatility in the estimation of money demand, interest rate targeting rules have gained ground over money supply rules. Taylor's (1993) seminal paper proposed a simple targeting rule and showed that there are important credibility gains to adhere to this rule.

$$R_t = 0.04 + 1.5 \cdot (\pi_t - 0.02) + 0.5x_t \quad [3]$$

R_r = Fed Funds rate (quarterly basis) Π_t = Inflation rate over the past four quarters

x_r= Deviations of real GDP from its linear trend

[3] It is noteworthy that the following equation will be called the Taylor rule further on, which is derived without any econometric estimation. However, there exists a whole family of rules derived from this one and thus will be designated as Taylor-type rules.

Hence, estimating the potential output as a linear trend of real GDP and taking the GDP deflator as a measure for inflation, the rule does a good job to explain the behavior of the Fed Funds rate over the period of 1987 to 1992. However, the period studied is quite short and the validity of the rule for other periods is questionable. Numerous studies have extended the application of the rule to other central banks and periods using different definitions and indices for output and inflation gaps.[4] On a theoretical perspective, Woodford (2001) evaluates the features of the rule and considers it as an optimal monetary policy on the basis that the output gap should be properly defined. It should be noted also that reacting to fluctuations in the inflation and output gaps are part of stabilization objectives embodied in a quadratic loss function. It is an abstraction spread in the monetary policy literature in order to compare the welfare of different rules. Hence, the objective is to minimize this function over many periods with a discount factor. This loss is illustrated for one period, where the parameter lambda determines the relative weight given to the output gap parameter.

$$L_t = \frac{1}{2}\left[\left(\pi_t - \pi^*\right)^2 + \lambda\left(x_t\right)^2\right]$$

In practice, even though the Taylor rule has been rather easy to grasp and corresponds to the objectives of a central bank basic goals, it has been strongly criticized. Kozicki (1999) selects four different indices for inflation and six for the output gap and examines the robustness aspects of the 24 different combinations. It appears that the results do not confirm robustness, since the range covered by the adjusted interest rates suggested by the different combinations is too large. If coefficients are sensitive to the selected indices, they are also on a time basis. Judd and Rudebusch (1998) estimate a Taylor-type rule over 1970 to 1997 and test for differences that would occur with shifts of the three different chairmen. The simple rule is augmented by lagged values of the interest rate and of the output gap and the estimation is performed with the interest rate in

[4] ECB: Sauer and Sturm (2003), Gerdesmeier and Roffia (2003); Bank of England: Nelson (2001); Bank of Canada: Côté, Kuszczak, Lam, Liu, St-Amant (2004); Fed: Kozicki (1999), Judd and Rudebusch (1998)

first-differences. It appears that the modified Taylor rule fits well the data to describe the conduct of monetary policy inside a chairman's mandate, but there are clearly breakpoints with the shift of a chairman. Therefore, the rule can distinguish between the different approaches towards inflationary pressures. It is also possible to infer that shifts in the policy rule may be caused by persistent real interest rate shocks that can have an effect on the intercept of the rule. In the context of an optimal monetary policy, Woodford (2001) asserts that the nominal interest rate should follow the developments in the wicksellian natural rate *(i.e. the equilibrium real rate under flexible price)* and thus advocates a variable intercept in the Taylor rule.

Uncertainty and real-time consideration

At the time where members of the MPC have to take their decision, they face limited and to some extent inaccurate information on the state of the economy. In this context, the optimality of a monetary policy would have to be reconsidered and take into account elements of uncertainty. This question is not new: in fact, Brainard (1967) argued that effectiveness should be conditioned by the level of uncertainty regarding the data and the parameters. Examining real-time data considerations for Taylor-type rules, Orphanides (2001) asserted that *"less activist rules prove more effective once the informational limitations encountered by policy makers in practice are considered."* Moreover, in the same study, the author shows that differences in the estimation of Taylor-type rules can lie in the fact that the data is either ex-post or in real-time. In most cases, results suggest that ex-post data provide more accurate and significant coefficients. Rudebusch (2001) also examined the important revisions in the output gap and judged that inertial responses are more related to data uncertainty than to parameter uncertainty.

Most of the studies deal with quarterly data, but when monetary policy is examined on a monthly basis, the question of uncertainty is emphasized. In fact, it is not a coincidence that 56% of the changes in the interest rate at the Bank of England between June 1997 and December 2006 occurred in the mid-months of the quarters. In those

months (February, May, August, November), the MPC's members have access to the statistics of the Inflation Report which are larger than on a monthly basis. For sure, availability of information is a key parameter in policymaking and individuals may value uncertainty differently. In practice however, it is hard to disentangle the reaction of an individual to economic variables from its valuation of uncertainty.

Forward-looking aspects of Taylor-type rules

"Monetary policy would aim consistently to achieve an inflation rate of 2.5% or less some two years ahead." Mervyn King (1997), Governor of the Bank of England (July 2003 – present)

Considering the transmission lags of monetary policy and the objectives of the central bank to maintain a certain level of inflation in the future (up to 8 quarters), forward-looking features have been added to the Taylor rule. Goodhart (2005) evaluates the sensitivity of the MPC's reaction function to the horizon of forecasted explanatory variables of the Taylor rule. Using the Inflation Report projections of inflation and output growth, the author substitutes the values at time t by their Bank's forecasts at time $(t+8)$. Results confirm that the MPC reacts significantly to developments of inflation in the future; however, the significance of forecasted output growth is disputable. On a theoretical basis, Batini and Haldane (1999) show support for the optimality of an inflation-based forecast rule when a simulation of a macro- model with shocks similar to the ones used in models at the Bank of England is performed. The forward-looking features of monetary policy are also assessed in Clarida, Gali and Gertler (2000) where a reaction function that nests the Taylor rule is introduced. In fact, the estimation of the rule with these forward-looking features appears quite effective in explaining the shift in monetary policy regimes since 1979 and the Volcker disinflation that followed. Considering the endogeneity of the expected inflation and output gaps, the equation is estimated by GMM where the instrumental variables are four lags in the inflation level,

output gap, federal funds rate and CPI, in addition to four lags of a financial informative variable: the short-long spread.

$$R_t = r^* + \beta\left(E\left[\pi_{t,k} \mid \Omega_t\right] - \pi^*\right) + \gamma E\left[x_{t,q} \mid \Omega_t\right]$$

r^* = long-run interest rate Ω = information set available to the central bank

k, q = number of quarters where inflation gap or output gap is predicted

Inertial behavior of the monetary policy

Another issue that has received a great level of interest in monetary policy is the smoothing of interest rates. In fact, adding the lagged interest rate to the Taylor rule raises significantly the explanatory power of an estimated reaction function. However, consensus has not been reached on the sources of this gradualism. A first assertion suggests that it is caused by the preference of policymakers to partially adjust the interest rate, since interest rate volatility is disliked. In fact, Woodford (2002) treats this aversion by adding a third component to the loss function: the variability of the interest rate itself. Moderate steps towards the preferred level of interest rate can be introduced in a reaction function such as the following one suggested in Clarida, Gali and Gertler (2000). Hence, the interest rate's behavior is constructed in two parts: lagged values and adjusted values from a Taylor rule estimation.

$$R_t = \rho(L)R_{t-1} + (1-\rho)\hat{R}_t$$

A second assertion considers that the inertial behavior in the interest rates corresponds to serially correlate omitted variables. In fact, according to Rudebusch (2002), smoothness is rather a reflection of an optimal reaction to new data that includes variables of high persistency, but these variables are in general not added in Taylor-type rules. This proposition finds support in the term structure of interest rates that do not show a large change in their predictability as should be expected if the central bank

adopted a predefined gradualist policy. The increasing significance power of estimating reactions functions when the error term is lagged also suggests that there are persistent influences of factors excluded from the rule. In the attempt to dissociate the effect of policy smoothing from omitted variables, Gerlach-Kristen (2004b) finds that both effects are significant and infers that financial market stability variables are the ones omitted in a Taylor-type rule. English, Nelson and Sack (2003) conclude in the same way: the behavior of the interest rate encloses the two effects. Setting aside economic and financial considerations, Goodhart (1999) argues that gradualism could also be attributed to institutional features. Hence, financial markets and economic agents would perceive frequent interest rates reversals as signs of incompetence and it would lessen the Bank's credibility.

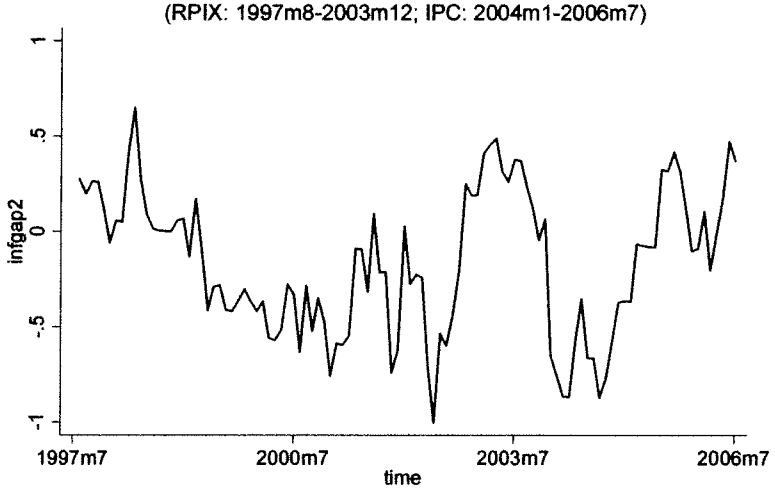
The weights assigned to contemporaneous values of output and inflation gaps in an estimated form of the Taylor rule properly summarize a member's behavior and easily allow for testing differences in the MPC. However, as it has been seen previously, the reaction function can be augmented by forward-looking and smoothing considerations, and that creates other parameters that can be tested. Even though the UK is an open economy, it is noteworthy that so far international factors such as foreign interest rates or exchange rates have been excluded from the analysis. In fact, Adam, Cobham and Girardin (2005) constructed a reaction function that includes the US and German interest rates and estimated it by GMM with a sample divided in three periods. From 1997 to 2002, it appears that international specifications are not significant. Finally, it should be noted that the task of this study is not to find a reaction function that would fit the most the data, but rather one that would have a sufficient explanatory power and that would allow tests on categories of members.

IV. Data and Transformations

Inflation

Over the sample, the Bank of England uses two different inflation target indices. Before January 2004, the target was set at 2.5% for the RPIX (retail excluding mortgage interest payments), whereas after this period the choice has been towards a 2% level in the CPI. The implementation of this change can also be viewed as a tentative towards harmonization of the target with other central banks. The inflation gap variable used in this paper follows the Bank objectives over time and thus excludes any impact that the break would have had due to the switch of indices. This problem is quite small, since from January 2004 to July 2006, the correlation between the two indices is strong (0.64) and, on average, the gaps are similar (RPIX=-0.21% and -0.22%).[5]

Figure 1 — Inflation Gap
(RPIX: 1997m8-2003m12; IPC: 2004m1-2006m7)



[5] Inflation has been calculated from the Office of National Statistics of the UK prices series (RPIX=CHMK and CPI=D7BT). Variables have been transformed according to a moving average suggested by Rudebusch (2002): $\pi_t = 1200(\ln P_t - \ln P_{t-1})$ and $\bar{\pi}_t = \frac{1}{12}\sum_{j=0}^{11}\pi_{t-j}$

Output gap

The estimation of the potential output remains problematic and the literature has not reached yet a consensus on this issue. In his seminal paper, Taylor (1993) simply extracts a linear trend and takes the de-trended values as the potential output. Even though this method has produced good results to explain the behavior of interest rates, it is however insufficient in capturing developments in the state of the economy. In the literature, extracting potential output estimates relies on numerous methods, including multivariate methods. Since the goal of this paper is to test differences in members' reactions functions, I judge that a rolling-time quadratic trend is satisfactory. Moreover, it should be noted that since data on output provided by the Office of National Statistics ONS is only on a quarterly basis, monthly observations have been obtained with interpolation methods.[6]

Capacity utilization (CU)

Since GDP goes through many revisions and there is an important lag before it becomes available, members may be tempted to base their decisions over other variables that can also reflect the state of economic activity. The alternative may be capacity utilization which is built from surveys to private firms. In fact, Rudebusch (2001), in his attempt to define an optimal monetary policy under uncertainty, showed that revisions in CU are smaller than ones in the output gap.[7]

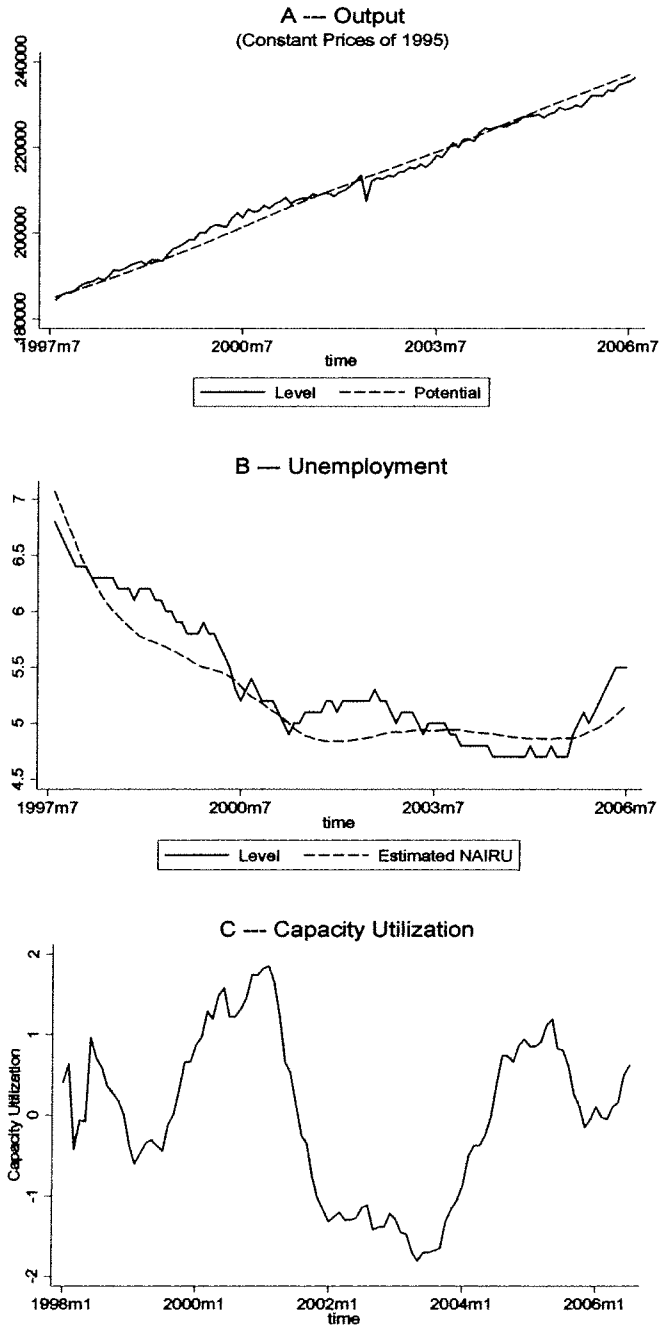
Unemployment

Third, the unemployment gap is also an indicator of the economic activity.[8] Since the level of unemployment has followed a downward trend over the sample period, it would not be appropriate to simply include its level in a reaction function. I thus constructed one that consists of the difference between contemporaneous unemployment and its natural level which is estimated by a rolling-time HP filter since January 1993. Furthermore, Orphanides and Williams (2002) show that the insertion of the first-

[6] Estimated series have been provided by Mitchell et al. (2005): "An indicator of monthly GDP and an early estimate of quarterly GDP growth" which produce an estimation of monthly GDP via interpolation methods starting from January 1973 (revised values)
[7] Bank of England, Inflation Report, August 2006, Survey Estimates of Private Sector Capacity Utilization
[8] Office of National Statistics, monthly level of unemployment: MGSX

difference in the level of unemployment improves the fit of the Taylor-type rule, so it has been added to the estimations.

Figure 2 — Economic Activity Indicators



V. Estimation with Contemporaneous Data

Although most studies on monetary policy rules are based on quarterly data, there are some limitations to doing so here. In this study, since decisions are made on a monthly basis, testing differences in members' behaviors implies that the rule should be estimated with monthly data. Throughout the sample, composition of the MPC differs since members' term lengths are not the same, causing estimation in panel data to be difficult to perform. Considering the short length of the sample, I do not account for any structural break, either for the change of the inflation target index or of the Governor. First, I estimate the simple Taylor rule by OLS with contemporaneous data and substitute at first the output gap by the unemployment gap and then by the capacity utilization (A, B, C).[9]

TABLE 1 — Determinants of the Interest Rate in Levels

	A	B	C
Constant	5.18 **(0.11)** ***	5.14 **(0.06)** ***	5.16 **(0.04)** ***
Inflation gap	0.95 **(0.11)** ***	0.31 **(0.11)** ***	0.73 **(0.09)** ***
Output gap	0.96 **(0.05)** ***		
Unemployment gap		-0.53 **(0.27)** **	
Δ Unemployment		-3.03 **(0.47)** ***	
Capacity utilization			0.78 **(0.02)** ***
R-square	0.428	0.07	0.468
*** / ** / * denotes respectively a significance level of 1%, 5% and 10% Standard errors in parenthesis are robust			

Coefficient signs are consistent with the prediction of the Taylor rule for all the economic activity variables and are mostly significant. However, substituting the output gap by unemployment variables reduces the explanatory power of the model. Estimation of the rule with the output gap produces some results that diverge from Taylor's original specification where the inflation gap and output gap are assigned respectively 1.5 and 0.5.

[9] Historical individual votes of the MPC are available on the Bank of England website's: www.bankofengland.co.uk

However, coefficients are still satisfactory for the purpose of testing different members' behaviors. Table 2 presents the results of an estimation allowing for different intercepts. Equality of all the intercepts is tested and the corresponding value of the F-statistic suggests that members' behaviors differ. Hence, members serving at the beginning of the sample seem to be more prone to hold higher constants, since the interest rate itself is higher during this sub-period.

Figure 3 — Prevailing Interest Rate
(1997m8-2006m7)

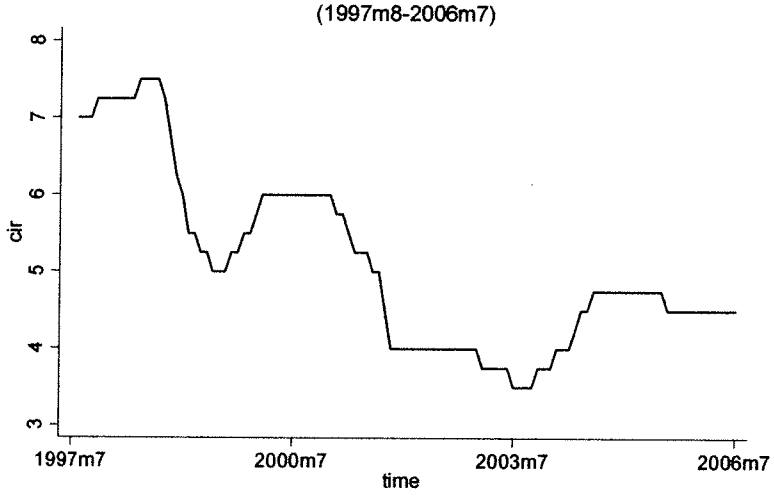
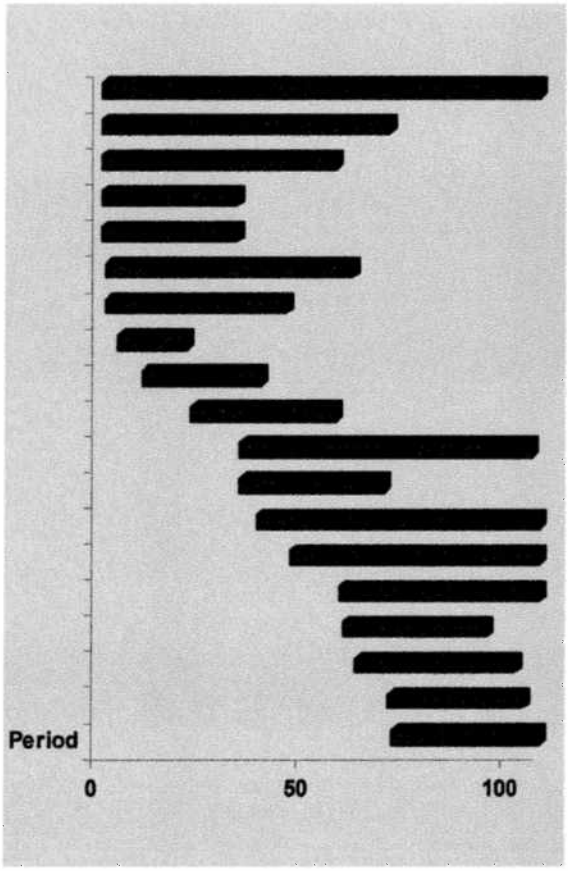


TABLE 2 --- Estimation of the Taylor Rule Allowing for Individual Intercepts

	Coefficient	Standard Error
Inflation gap	0.63 ***	0.09
Output gap	0.62 ***	0.05
Intercept per member		
Mervyn King	5.21 ***	0.09
Sir Edward George	5.41 ***	0.12
Ian Plenderleith	5.61 ***	0.13
Willem Buiter	6.01 ***	0.17
Charles Goodhart	6.03 ***	0.17
David Clementi	5.58 ***	0.13
De Anne Julius	5.76 ***	0.13
Sir Alan Budd	6.48 ***	0.18
John Vickers	5.63 ***	0.15
Sushil Wadhwani	4.97 ***	0.08
Stephen Nickell	4.77 ***	0.08
Christopher Allsopp	4.8 ***	0.11
Charles Bean	4.79 ***	0.08
Kate Barker	4.66 ***	0.08
Paul Tucker	4.71 ***	0.09
Marian Bell	4.51 ***	0.11
Sir Andrew Large	4.67 ***	0.1
Sir Richard Lambert	4.73 ***	0.12
Rachel Lomax	4.76 ***	0.11

F-statistic testing all constants equal = 12.95***
*** / ** / * denotes respectively 1%, 5% and 10% significance level
Standard errors are robust

Figure 4 --- Duration of Members Serving in the MPC



In fact, the differences in the intercepts may be due to time-dependent factors rather than to a change in the composition of the MPC. For instance, splitting the decisions of one member, the former Governor Sir Edward George, into two equal sub-samples: before and after of July 2000, the estimates for the intercepts are 6.01 and 4.86. It should be noted that the reaction function based on the Taylor rule is still useful in order to appreciate the differences in member behaviors of a same period. Nonetheless, it seems rather pointless to test behaviors that belong to different periods since time-dependent parameters are dominant.

In order to isolate these time effects from the decisions, I cluster members into categories that are fixed in number over the sample. For instance, the MPC is composed of 5 internal members, including the Governor, and 4 external ones, appointed by the chancellor of exchequer. Since we are interested to know if one category privileges a tighter or looser policy, a dummy variable that corresponds to the internal member's votes captures this effect. Results shown in Table 3 do not provide any evidence that members would they be internal or external choose an interest rate differently. The results are not shown here, but I also allowed for a different inflation gap and when I tested the equality of the coefficients, it was not rejected at a level of over 20% of significance. If I allow for the three different economic activity indicators to differ, p-values exceed 50%.

TABLE 3 --- The Insider Effect with the Interest Rate in Levels

	A	B	C
Constant	5.17 **(0.05)** ***	5.13 **(0.08)** ***	5.16 **(0.05)** ***
Internal members	0.04 **(0.06)**	0.01 **(0.07)**	-0.005 **(0.05)**
Inflation gap	0.95 **(0.11)** ***	0.31 **(0.11)** ***	0.73 **(0.09)** ***
Output gap	0.96 **(0.05)** ***		
Unemployment gap		-0.53 **(0.27)** **	
Δ Unemployment		-3.03 **(0.47)** ***	
Capacity utilization			0.78 **(0.02)** ***
*** / ** / * denotes respectively a significance level of 1%, 5% and 10% Standard errors in parenthesis are robust			

In order to find other common characteristics of members that could potentially be a source of divergence in the votes, I follow Spencer (2006a) and consider the member's most important career background prior to serve in the MPC. I classify these positions into three categories: the Bank itself, in academia or in the private sector. The intuition is that a group of people with similar background may behave the same way regarding the importance to give to certain variables. Figure 4 illustrates the composition of the MPC. It seems that there is a small bias towards more members coming from academia at the

beginning of the sample and more coming from the private sector at the end. In Table A-1, members of the MPC are classified according to their career background.

Figure 5 --- Composition of the MPC

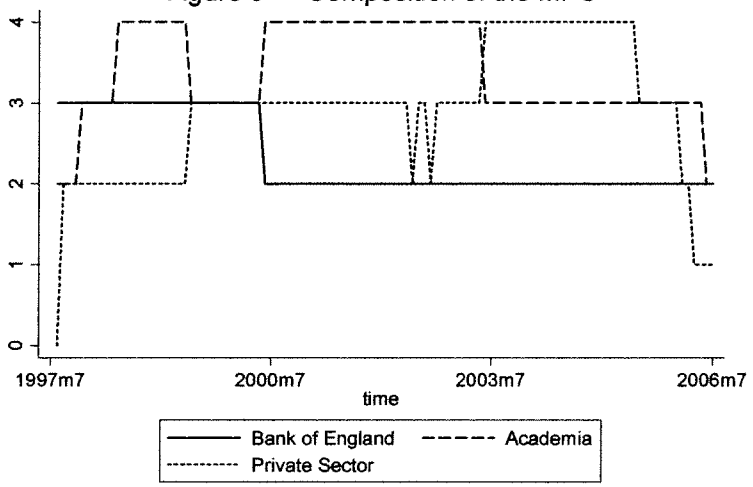


TABLE 4 — The Career Background Effect with the Interest Rate in Levels

	A	B	C
Bank	5.31 **(0.06)** ***	5.33 **(0.09)** ***	5.27 **(0.06)** ***
Academia	5.2 **(0.05)** ***	5.16 **(0.08)** ***	5.19 **(0.05)** ***
Private Sector	5.07 **(0.05)** ***	4.98 **(0.08)** ***	5.03 **(0.05)** ***
Inflation gap	0.93 **(0.11)** ***	0.31 **(0.11)** ***	0.72 **(0.08)** ***
Output gap	0.95 **(0.05)** ***		
Unemployment gap		-0.59 **(0.27)** **	
Δ Unemployment		-2.91 **(0.47)** ***	
Capacity utilization			0.78 **(0.02)** ***
F-stat (testing the intercepts equal)	5.48 ***	6.98 ***	7.61 ***

*** / ** / * denotes respectively a significance level of 1%, 5% and 10%
Standard errors in parenthesis are robust

When individuals are classified according to their career background, results show significant differences in the category intercepts. However, there are no significant differences when I allow for three inflation gap's coefficients and three economic activity indicator's coefficients. Spencer (2006b) is also based on the dissension of members towards the Governor's decision since 1997 and the main finding is that members with a private sector background are more prone to adopt lower interest rates. In fact, this category of members may share similar concerns over the stimulation of production. Nonetheless, it is misleading to argue that there is a causal link between member backgrounds and votes for lower interest rates, since averages of interest rates faced by this category of members were lower for this category. The averages are 5.27, 5.1 and 4.93 for members with backgrounds respectively at the Bank, in academia and in the private sector. Since members that come from the private sector are larger to the end of the sample, it is rather difficult to dissociate the time-effect from a dovish behavior. Additional tests should thus be conducted to test the validity of this relation.

Up to this point, the reaction functions estimated in levels have not let us appreciate divergences between members' votes; since the monthly decisions do not differ considerably. In fact, the level of dissension in one meeting has not reached a spread greater than fifty basis points. Although most of the literature deals with interest rates in levels, Levin, Wieland and Williams (1999) show that rules in first-differences produce better results at reducing the variability of both inflation and output gaps. The following analysis will thus address the question of testing differences in members' behaviors with interest rates in first-differences. It should be noted that there is also an econometric consideration to the estimations in first-differences. In fact, a Dickey-Fuller statistic of -1.59 detected the presence of a unit root in the interest rate. Hence, the dependent variable I will use later in this paper is the difference between the individual decision and the chosen interest rate selected by the MPC the previous month. Since decisions are made on a scale of 25 basis points, estimation is performed by ordered probit. Figure 6 suggests that the dependent variable would take three values (-1, 0, 1) that represent a vote for looser policy, for no change and for a tighter policy.

Figure 6 --- MPC Decisions Aggregated for all Members
(1997m8-2006m7)

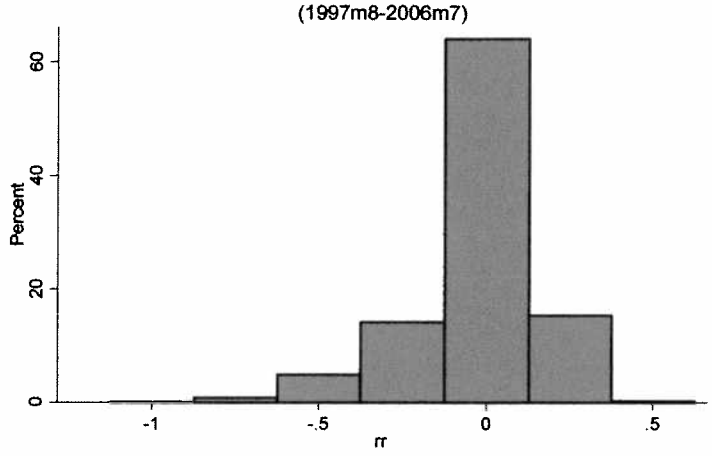


TABLE 5 --- Determinants of the Interest Rate in First-Differences

	A	B	C
Inflation gap	-0.37 **(0.13)** ***	-0.42 **(0.1)** ***	-0.42 **(0.1)** ***
Output gap	0.09 **(0.05)** *		
Unemployment gap		-2.14 **(0.28)** ***	
Δ Unemployment		0.54 **(0.54)**	
Capacity utilization			0.11 **(0.04)** ***
Cut (λ_{-1})	-0.78	-1.01	-0.75
Cut (λ_{1})	1.1	0.95	1.12
Pseudo-R^2	0.013	0.05	0.012

Maximum likelihood estimation by ordered probit
*** / ** / * denotes respectively a significance level of 1%, 5% and 10%
Standard errors in parenthesis are robust

First, it is important to understand that estimated values obtained by ordered probit refer to probabilities that a decision be directed either toward a decrease, an increase or toward no change at all. A puzzling result is the negative sign of the inflation gap's coefficient, since, according to the Taylor rule, a positive value is expected. It is

also robust to the substitution of the output gap by an unemployment gap and a capacity utilization variable. The low values of the pseudo-R^2, a measure of explanatory power for non-linear models, also questions the relevance of the estimation in first-differences.

TABLE 6 — The Insider Effect with the Interest Rate in First-Differences

	A1	A2	B1	B2	C1	C2
Internal members	0.32 **(0.08)** ***		0.35 **(0.08)** ***		0.32 **(0.08)** ***	
Inflation gap	-0.38 **(0.1)** ***	-0.37 **(0.1)** ***	-0.43 **(0.1)** ***	-0.43 **(0.1)** ***	-0.43 **(0.1)** ***	-0.42 **(0.1)** ***
Output gap	0.1 **(0.05)** **	0.18 **(0.09)** ***				
Output gap * Internal		-0.16 **(0.09)** *				
Unemployment gap			-2.2 **(0.28)** ***	-2.97 **(0.38)** ***		
Unemp. gap * Internal				1.41 **(0.42)** ***		
Δ Unemployment			0.55 **(0.54)**	0.53 **(0.54)**		
Capacity utilization					0.11 **(0.04)** ***	0.13 **(0.06)** **
Cap. Util. * Internal						-0.04 **(0.07)**
L.-R. Test	14.26 ***	3.11 *	19.87 ***	10.43 ***	17.24 ***	0.34

Maximum likelihood estimation by ordered probit
*** / ** / * denotes respectively a significance level of 1%, 5% and 10%
Standard errors are robust

The results shown in Table 6 are robust to the fact that internal members prefer a tighter policy. The values of the likelihood ratio tests, the statistic used in non-linear models, provide evidence for this fact. On the other hand, allowing coefficients to differ for the output gap and the capacity utilization does not lead to significant results. Hence, according to these results, insiders and outsiders seem to personify the hawks and the doves depicted in the British press. In fact, at the Bank of England, the Governor receives orders from the chancellor of exchequer to keep the inflation gap in the range of ± 1%. Perhaps in the sample, risks to attain the upper bound have been more marked, forcing him to adopt a hawkish position. Considering career perspectives of internal members and the peer pressure they face when they work at the Bank, may create incentives to vote for the Governor's proposal. These members could also vote in favor of a tighter policy

in the purpose of building their own reputation. Finally, the difference in the votes of these two categories could also lie in the fact that the chancellor of exchequer and his government would benefit from the appointment of a dove.

TABLE 7— The Career Background Effect with the Interest Rate in First-Differences

	A1	A2	B1	B2	C1	C2
Academia	-0.08 **(0.09)**		-0.08 **(0.09)**		-0.05 **(0.1)**	
Private Sector	-0.15 **(0.09)**		-0.2 **(0.09)** **		-0.11 **(0.09)**	
Inflation gap	-0.39 **(0.1)** ***	-0.38 **(0.1)** ***	-0.43 **(0.1)** ***	-0.42 **(0.1)** ***	-0.36 **(0.1)** ***	-0.43 **(0.1)** ***
Out. Gap	0.09 **(0.05)** *					
Out. Gap * Bank		-0.01 **(0.08)**				
Out. Gap * Acad.		0.26 **(0.08)** ***				
Out. Gap * P.S.		-0.05 **(0.08)**				
Unemp. Gap			-2.19 **(0.28)** ***			
Δ Unemp.			0.62 **(0.54)**	0.62 **(0.54)**		
Unemp. Gap * Bank				-1.73 **(0.39)** ***		
Unemp. Gap * Acad.				-2.36 **(0.39)** ***		
Unemp. Gap * P.S.				-2.26 **(0.41)** ***		
Cap. Util.					0.11 **(0.04)** ***	
Cap. Util. * Bank						0.1 **(0.06)**
Cap. Util. * Acad.						0.22 **(0.06)** ***
Cap. Util. * P.S.						0.01 **(0.06)**
L.-R. Test	2.30	9.74 ***	4.31	1.62	1.93	6.82 **

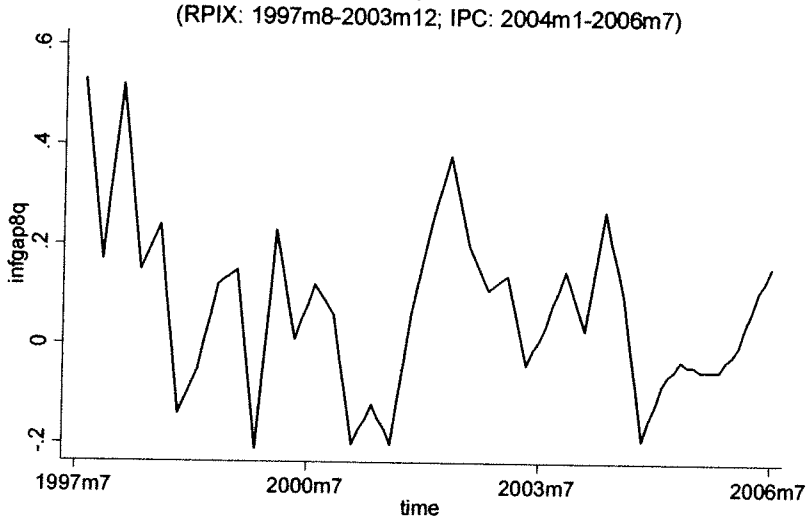
Maximum likelihood estimation by ordered probit
*** / ** / * denotes respectively a significance level of 1%, 5% and 10%
Standard errors are robust

In the case of tests for differences caused by dissimilar career backgrounds, it appears that the output gap and capacity utilization's coefficients for members with a background in academia are larger and more significant. In the study of monetary policy from another era, it would have been argued that this difference lies in the allegiance to

the Keynesian or monetarist school of thought.[10] However, in the period studied under the governance of George and King, the theoretical background of MPC's members is relatively similar. The difference may thus lie in the fact, that this category is more concerned with objectives of economic stimulation.

VI- Forward-Looking Considerations in Policy Evaluation

Figure 7 --- Inflation Gap at an 8-Quarter Horizon
(RPIX: 1997m8-2003m12; IPC: 2004m1-2006m7)



Even though the Taylor rule describes monetary policy with contemporaneous measures of output and inflation, effects of a monetary shock are transmitted with some lags to the economy. In fact, the macroeconometric models used at the Bank of England[11] predict a transmission process of the monetary policy where effects on the level of output only arise after 5 quarters and reach a peak 8 quarters following the shock. In fact, it lies at the center of central banks' concerns in the way Chairman Alan Greenspan addressed the question: "Because monetary policy works with a lag, it is not the conditions

[10] In fact, Chappell et al. (2004) found historical support for this assertion.
[11] Before 2004 it is the Medium Term Macro Model (MTMM) and after 2004 the Bank of England Quarterly Model (BEQM)

prevailing today that are critical but rather those likely to prevail six to twelve months, or even longer, from now." (January 21, 1997 testimony by Chairman Greenspan before the Senate Committee on the Budget) Since 1997, the Bank of England publishes quarterly forecasts of inflation and output growth up to eight quarters ahead of time.[12] Linear interpolation methods allow us to transform the selected series at different horizons on a monthly basis. It should be noted that the predictions for the output variable are excluded from the estimations, since its measure in growth rate would make the comparison difficult with the output gap estimations.

TABLE 8 — Determinants of the Interest Rate in Levels at Different Horizons

k=	1	2	4	8
A				
Constant	5.2 **(0.05)** ***	5.23 **(0.05)** ***	5.27 **(0.05)** ***	5.00 **(0.03)** ***
E (Inflation gap $_{t+k}$)	1.02 **(0.12)** ***	1.19 **(0.11)** ***	1.41 **(0.11)** ***	1.34 **(0.24)** ***
Output gap	0.9 **(0.03)** ***	0.96 **(0.04)** ***	0.87 **(0.03)** ***	0.84 **(0.03)** ***
R-square	0.406	0.427	0.431	0.376
B				
Constant	5.19 **(0.07)** ***	5.17 **(0.07)** ***	5.3 **(0.07)** ***	5.03 **(0.04)** ***
E (Inflation gap $_{t+k}$)	0.52 **(0.15)** ***	0.42 **(0.14)** ***	1.09 **(0.16)** ***	0.81 **(0.26)** ***
Unemployment gap	-0.61 **(0.28)** **	-0.62 **(0.28)** **	-0.72 **(0.26)** ***	-0.44 **(0.09)** *
Δ Unemployment	-2.95 **(0.48)** ***	-2.97 **(0.47)** ***	-2.55 **(0.46)** ***	-2.8 **(0.48)** ***
R-square	0.076	0.071	0.111	0.071
C				
Constant	5.3 **(0.04)** ***	5.26 **(0.04)** ***	5.27 **(0.04)** ***	4.88 **(0.03)** ***
E (Inflation gap $_{t+k}$)	1.55 **(0.12)** ***	1.31 **(0.11)** ***	1.41 **(0.13)** ***	2.26 **(0.24)** ***
Capacity utilization	0.89 **(0.02)** ***	0.86 **(0.03)** ***	0.75 **(0.02)** ***	0.81 **(0.02)** ***
R-square	0.543	0.512	0.506	0.492
*** / ** / * denotes respectively a significance level of 1%, 5% and 10% Standard errors in parenthesis are robust				

[12] Inflation Report (1997 and subsequently). The following estimations are based on the mean expected of the inflation index (RPIX: 1997m8-2003m12 and IPC: 2004m1-2006m7).

The results are consistent with those where a contemporaneous inflation gap has been used. It appears that the explanatory power is greater with the capacity utilization variable. The most striking result, however, is the growing weight given to the inflation gap with longer horizons. It can thus illustrate the concerns of the MPC for future economic conditions. In fact, Orphanides (2001) examined the Fed's monetary policy from 1997q1 to 1992q2 with real-time predictions and found the same result: the significance of the inflation gap coefficient increases with longer horizons.

TABLE 9 — Determinants of the Interest Rate in First-Differences at Different Horizons

k =	1	2	4	8
A				
E (Inflation gap $_{t+k}$)	-0.37 **(0.14)** ***	-0.64 **(0.14)** ***	-0.4 **(0.17)** **	2.53 **(0.25)** ***
Output gap	0.11 **(0.15)** **	0.07 **(0.05)**	0.13 **(0.15)** ***	0.17 **(0.04)** ***
Pseudo R^2	0.01	0.009	0.019	0.064
B				
E (Inflation gap $_{t+k}$)	-0.35 **(0.13)** ***	-0.6 **(0.14)** ***	-0.37 **(0.18)** **	2.36 **(0.27)** ***
Unemployment gap	-2.09 **(0.28)** ***	-2.02 **(0.28)** ***	-2.09 **(0.28)** ***	-2.12 **(0.28)** ***
Δ Unemployment	0.48 **(0.54)**	0.44 **(0.55)**	0.38 **(0.56)**	1.31 **(0.58)** **
Pseudo R^2	0.044	0.052	0.043	0.088
C				
E (Inflation gap $_{t+k}$)	-0.37 **(0.14)** ***	-0.73 **(0.14)** ***	-0.48 **(0.17)** ***	3.64 **(0.32)** ***
Capacity utilization	0.11 **(0.04)** ***	0.07 **(0.04)** *	0.14 **(0.04)** ***	0.35 **(0.04)** ***
Pseudo R^2	0.014	0.026	0.016	0.101

Maximum likelihood estimation by ordered probit
*** / ** / * denotes respectively a significance level of 1%, 5% and 10%
Standard errors in parenthesis are robust

Surprisingly, in first-differences, the inflation gap coefficient is reverted and is significantly positive at an 8-quarter horizon. Increases in the model's explanatory power

are also interesting (it is 7 times larger in the estimation with the capacity utilization) and reassert the importance of forward-looking variables in a reaction function.

TABLE 10 — The Insider Effect and the Inflation Gap at an 8-quarter Horizon

	A	B	C
E (Inflation gap $_{t+8}$)	2.68 **(0.35)** ***	2.5 **(0.38)** ***	3.84 **(0.43)** ***
E (Infl. gap $_{t+8}$) * Internal	-0.27 **(0.43)**	-0.25 **(0.45)**	-0.25 **(0.45)**
Output gap	0.17 **(0.05)** ***		
Unemployment gap		-2.12 **(0.29)** ***	
Δ Unemployment		1.3 **(0.58)** **	
Capacity utilization			0.35 **(0.5)** ***
L.-R. Test	0.35	0.28	0.46

Maximum likelihood estimation by ordered probit
*** / ** / * denotes respectively a significance level of 1%, 5% and 10%
Standard errors in parenthesis are robust

Since the estimation with inflation at an 8-quarter horizon clearly distinguishes itself from other horizons, the insider and career background effects are examined considering this horizon. In the case of the insider effect, testing differences on interactions with economic activity variables are not significant, so I only focus on the inflation gap. To be sure, the longer horizon for the inflation gap does not seem to have any effect on the differences in weights assigned to this gap. As for the career background effect, Table 11 confirms the robustness of previous results with the introduction of a forward-looking variable. In fact, it appears that academics still assign a greater weight to the output gap.

TABLE 11 --- The Career Background Effect and the Inflation Gap at an 8-quarter Horizon

	A1	A2	B1	B2	C1	C2
E (Inflation gap $_{t+8}$)		2.59 **(0.25)** ***		2.39 **(0.27)** ***		3.67 **(0.31)** ***
E (Infl. gap $_{t+8}$) * Bank	2.14 **(0.36)** ***		1.83 **(0.4)** ***		3.11 **(0.48)** ***	
E (Infl. gap $_{t+8}$) * Acad.	3.01 **(0.38)** ***		2.93 **(0.41)** ***		4.26 **(0.45)** ***	
E (Infl. gap $_{t+8}$) * P.S.	2.34 **(0.4)** ***		2.18 **(0.42)** ***		3.43 **(0.49)** ***	
Out. Gap	0.18 **(0.04)** ***					
Out. gap * Bank		0.07 **(0.08)**				
Out. gap * Acad.		0.38 **(0.08)** ***				
Out. gap * P.S.		0.02 **(0.08)**				
Unemp. Gap			-2.15 **(0.29)** ***			
Δ Unemp.			1.3 **(0.42)** **	1.33 **(0.58)** **		
Unemp. gap * Bank				-1.54 **(0.4)** ***		
Unemp. gap * Acad.				-2.44 **(0.4)** ***		
Unemp. gap * P.S.				-2.28 **(0.42)** ***		
Cap. Util.					0.36 **(0.4)** ***	
Cap. Util. * Bank						0.32 **(0.08)** ***
Cap. Util. * Acad.						0.48 **(0.07)** ***
Cap. Util. * P.S.						0.24 **(0.07)** ***
L.-R. Test	2.88	12.38 ***	4.13	3.17	3.76	7.51 **

Maximum likelihood estimation by ordered probit
*** / ** / * denotes respectively a significance level of 1%, 5% and 10%
Standard errors in parenthesis are robust

VII- Conclusion

For nearly fifteen years, the Taylor rule has been at the center of the literature on monetary policy rules. Gaining ground at first for its parsimony, it led to extensions dealing with the inertia in the interest rates and forward-looking features. At about the same time in developed countries' central banks, reforms were progressing in order to increase the institution's independence from the government. Hence, since June 1997 at the Bank of England, the interest rates are adopted by a committee structure. Interest rate targeting rules such as the Taylor rule are thus interesting when applied to the purpose of examining the different behaviors of members. In fact, its estimation produces a satisfactory proxy for an individual reaction function, in particular when the capacity utilization variable is chosen over the output gap. However, the task of categorizing members as either doves or hawks is unattainable, since it is too difficult to isolate the time-effect from the individual decisions. Therefore, instead of estimating individual reaction functions, I chose to cluster individuals accordingly to their intern or extern status at the Bank and their most important career background sector: at the Bank itself, in academia or in the private sector.

When testing differences in the weights that these groups allocate to the output and inflation gap coefficients, it appears that the estimations in levels are uninteresting, which has been a consequence of the narrowness in the decisions. The focus further on has been placed on the rule in first-differences, which is in fact closer to the decisions that a member faces. An unexplained result is the inflation gap estimates that take the opposite from the expected sign. Another result is the observation of a higher level of dissension for ease by external members. In fact, it remains the only significant difference between these two groups, since there are no significant differences in the estimations of the inflation and output gaps' coefficients. In regards to the categorization approach by the career background, it appears that the only interesting characteristic that remains is the greater weight assigned to the output gap or to the capacity utilization variable by members with background in academia. The two results are robust to a forward-looking specification that uses the expected value of the inflation gap at different horizons.

Moreover, considering the increasing explanation power and the reversion to the positive sign for the inflation gap for longer horizons, it suggests that the MPC considers horizons as long as 8-quarter. In fact, it corresponds to the Bank of England's objective which is to target the stabilization of inflation two years ahead, a topic discussed by the Governor himself.

Actually, the considerable power exerted by the Governor in the final decision is an issue that has not been given much attention in the new literature on committee structures. Over the 108 meetings analyzed, his proposals have been adopted in all but one meeting. The importance of this decisional power thus suggests that other members are less important in the decisional process. In short, the Governor's influence may emphasize the fact that only small differences in the coefficients for categories of members are assessed. Finally, the voting record sample is rather short and deals mainly with a period of decreasing interest rates. In order to test the symmetry of the reaction functions, it would be interesting to examine a period where the interest rate completes a whole cycle. In the future, structural breaks, such as the one in January 2004 involving a change in the inflation target index, could also be tested.

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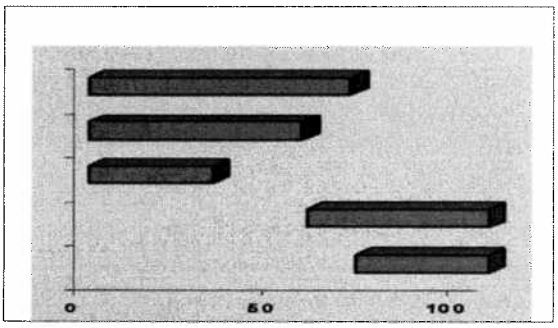
Appendix

TABLE A.1 --- Career Background Prior to Joining the MPC

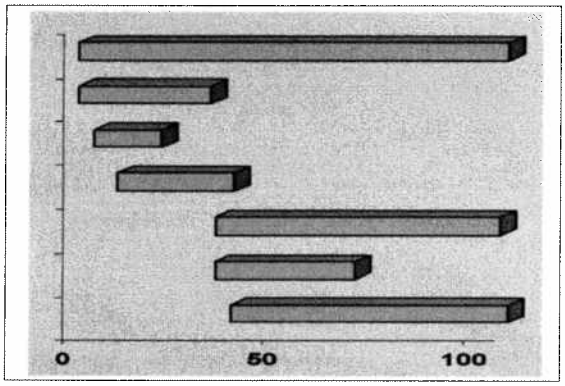
Bank of England

Sir Edward George
Ian Plenderleith
Charles Goodhart
Paul Tucker
Rachel Lomax *



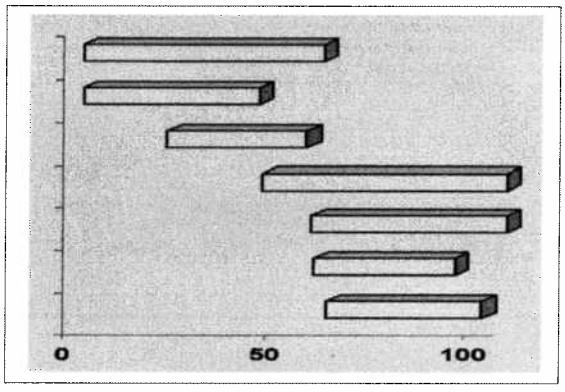
Academia

Mervyn King
Willem Buiter
Sir Alan Budd
John Vickers
Stephen Nickell
Christopher Allsopp
Charles Bean



Private Sector

David Clementi
De Anne Julius
Sushil Wadhwani
Kate Barker
Marian Bell
Sir Andrew Large
Sir Richard Lambert



* By simplicity, Ms. Lomax is attached to the Bank category, even though most of her career has been devoted to the UK government.