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Delayed Doves: MPC Voting Behaviour of Externals

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Abstract
The use of independent committees for the setting of interest rates, such as the Monetary Policy Committee (MPC) at the Bank of England, is quickly becoming the norm in developed economies. In this paper we examine the issue of appointing external members (members who are outside the staff of the central bank) to these committees. We construct a model of MPC voting behaviour, and show that members who begin voting for similar interest rates should not systematically diverge from each other at any future point. However, econometric results in fact show that external members initially vote in line with internal members, but after a year, begin voting for substantially lower interest rates. The robustness of this effect to including member fixed effects provides strong evidence that externals behave differently from internals because of institutional differences between the groups, and not some unobserved heterogeneity. We then examine whether career concerns can explain these findings, and conclude that they cannot.

JEL Classifications: E58 and D71
Key Words: Monetary Policy Committee (MPC), Bank of England, Committee Voting, Signalling

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1 Introduction

In recent years, many central banks, including those in Australia, New Zealand, the UK, and the EU have turned over authority for setting interest rates to independent committees in order to limit politicians' ability to manipulate interest rates, and to allow trained experts to conduct monetary policy rather than less specialized politicians. While there is widespread agreement[1] on the advantages of independent committees, numerous important issues about their optimal structure are still unresolved. One such matter is whether people from outside the world of central banking should have places on the committee. The issue is of direct relevance. In the UK the Chancellor of the Exchequer directly appoints four of the nine members of the Monetary Policy Committee (MPC) from outside the Bank of England–the so called external members– and replaces or reappoints them every three years. The Reserve Bank of Australia's 9-person committee responsible for monetary policy decisions (Reserve Bank Board) contains 6 external members. By contrast, all members of the Federal Reserve's Federal Open Market Committee (FOMC) are employed in senior positions by either the Board of Governors or the regional Federal Reserve Banks, and the European Central Bank has a twenty-one person committee with no external members, although some have called for the introduction of a smaller committee including external members[2].

As the MPC is the primary example of a committee divided between internal and external members, studying its members' voting behaviour is a natural starting point to address whether committees should include outsiders[3]. Previous research, discussed more fully below, has noted different voting patterns among externals and internals. In particular, externals vote for lower interest rates and dissent more than internals. While noting the same patterns, this paper moves substantially beyond these descriptive observations and provides three major and novel results. First, external members vote for substantially lower interest rates and behave more heterogeneously than internals even after controlling for occupation, education, age, committee composition, and economic conditions. Thus, external members behave differently from internals not because of different backgrounds, but simply because they are external, meaning something inherent to the institution causes voting differences[4]. Another way of stating this result is that appointing people from outside central banking to the committee does not change voting as such; of greater importance is whether these outsiders are given managerial responsibilities and future career prospects in the Bank. For example, in Brazil and Sweden outsiders are appointed to the monetary policy making committees, but on appointment these outsiders become members of central bank staff. Our results suggest this design is fundamentally different from the UK's practice of employing outsiders only for their MPC duties.

Our next finding is also our most important one: the difference in voting level arises entirely from experienced committee members. When they first join the committee, internals and externals are indistinguishable in their voting levels; after serving for a year, externals begin voting for lower interest rates. A voting model in which all members are rational, Bayesian updaters maximizing the same objective function predicts that committee members in initial agreement on the correct interest rate will not diverge from each other at any future point. The fact that our econometric findings contradict this pattern means we can rule out the possibility that

[1] See, for example, experimental studies such as Blinder and Morgan (2005) and Lombardelli et al (2005), or theoretical such as Gerlach-Kristen (2006).

[2] See Wyplosz and Artus (2002).

[3] The Reserve Bank of Australia has only recently started to publish minutes of their Reserve Bank Board meetings and no voting records are published.

[4] To take one example, Charles Bean and Steve Nickell were both economics professors at the London School of Economics prior to the former's appointment as an internal and the latter's as an external.

internals and externals both exhibit ideal behaviour[5]. Thus, either internals or externals create agency costs for society since one of the two groups fails to behave ideally. To our knowledge, this paper is the first to point out the normative implications of the MPC voting record.

If internal or external members depart from ideal behaviour, the next obvious question is what incentives drive voting. Our last finding is that there is no evidence of externals' behaving differently from internals because of signalling. This result is interesting in light of the emphasis placed on signalling in several recent papers on committee voting (for example Levy (2007) and Meade and Stasavage (2008)). First, academic and non-academic members behave equivalently in a statistically sense. Second, members who vote knowing reappointment is possible do not differ from members who believe reappointment is not possible.

Although these findings do not in themselves provide a complete answer as to whether externals should have a voice in monetary policy making, they do highlight important considerations that governments should keep in mind when designing committees. First, internal and external members do differ markedly in their behaviour, so there are real effects of including both types on a committee. Second, because of their greater voting volatility, externals reduce social welfare under a standard concave loss function. Finally, in the UK at least, either one or both of the groups behaves contrary to the government's wishes. Unfortunately, the paper does not provide a statistical test of which one does. While it may be tempting to suspect that it is the externals because of their downward voting trend, internals could just as well hold excessively rigid views and fail to adjust their beliefs about correct monetary policy making. We do not view the incompleteness of this answer as a limitation, but rather as a stimulus for building and testing models of committee decision making to account for the results, and a warning to governments to not to assume ideal behaviour from those charged with conducting monetary policy.

In the next section we provide details about the history and structure of the MPC and review previous research in this area. The third section constructs a simple model of ideal committee voting. The fourth section describes the voting data and the econometric model before presenting empirical findings that contradict the ideal voting model. The fifth section presents evidence against signalling incentives among external members, and discusses implications for committee design. The final section concludes.

2 MPC Background and Literature Review

Up until 1997 the Chancellor of the Exchequer (the Minister in charge of the Treasury Department) had sole responsibility for setting interest rates in the UK. One of Gordon Brown's first actions on becoming Chancellor in the Blair government was to set up an independent committee for setting interest rates in order to make monetary policy less arbitrary and susceptible to election cycles. The MPC first convened on 6 June 1997, and has met every month since. Majority vote determines the rate of interest. Its remit, as defined in the Bank of England Act (1998) is to "maintain price stability, and subject to that, to support the economic policy of Her Majesty's government, including its objectives for growth and employment."[6] In practice, the

[5] We show that it cannot be the case, for example, that external members begin with a high degree of uncertainty about how to vote, but gain more confidence through time in their views and deviate from the internals.

[6] "The Bank of England Act came into effect on 1 June 1998. The Act states that in relation to monetary policy, the objectives of the Bank of England shall be:

(a) to maintain price stability, and

(b) subject to that, to support the economic policy of Her Majesty's Government, including its objectives for growth and employment.

In order to comply with the Act, this remit sets out what price stability shall be taken to consist of and what the economic policy of the Government shall be taken to be."

committee seeks to achieve a target inflation rate of 2%, based on the Consumer Price Index[7]. If inflation is greater than 3% or less than 1% the Governor of the Bank of England must write an open letter to the Chancellor explaining why. The inflation target is symmetric; missing the target in either direction is treated with equal concern.

The MPC has nine members; five of these come from within the Bank of England: the Governor, two Deputy Governors, the Chief Economist, and the Executive Director for Market Operations. The Chancellor also appoints four members (subject to approval from the Treasury Select Committee) from outside the Bank. There are no restrictions on who can serve as an external member. According to the Bank of England, the purpose of external appointments is to "ensure that the MPC benefits from thinking and expertise in addition to that gained inside the Bank of England." Bar the governors, all members serve three year terms; the governors serve five year terms. When members' terms end, they can either be replaced or re-appointed. Through August 2007, 25 different members have served on the MPC – 11 internal members and 14 external members. Each member is independent in the sense that they do not represent any interest group or faction. The Bank encourages members to simply determine the rate of interest that they feel are most likely to achieve the inflation target - "The MPC's decision is made on the basis of one-person, one vote. It reflects the votes of each individual member of the Committee" (Bank of England website).

The MPC meets on the first Wednesday and Thursday of each month. In the month between meetings, members receive numerous briefings from Bank staff and regular updates of economic indicators. On the Friday before MPC meetings, members gather for a half-day meeting in which they are given the latest analysis of economic and business trends. On the Wednesday of the meeting, members discuss their views on several issues. The discussion continues on Thursday morning; each member is given some time to summarise their views to the rest of the MPC, and suggest what vote they favour (although they can, if they wish, wait to hear the others views before committing to a vote (Lambert, 2006)). This process begins with the Deputy Governor for monetary policy, concludes with the Governor, and other members are selected at random order in between. To formally conclude the meeting, the Governor suggests an interest rate that he believes will command a majority. Each member then chooses whether to agree with the Governor's decision, or dissent and state an alternative interest rate. The MPC decision is announced at 12 noon. Two weeks after each meeting, members' votes are published, along with minutes of the meeting with full, but unattributed comments.

In the analysis below, we take for granted that there is transparency of voting behaviour of MPC members and MPC meeting minutes are published; without such a design structure, the nature of our empirical work would be impossible. As a result our paper is not contributing to general discussion of whether having a committee influences monetary policy outcomes (interested readers are pointed toward Sibert (2006), Sibert (2003) and the references therein), or on the debate about optimal degree of transparency (see, for example, Geraats (2006) and Sibert (2002)).

Our main findings on the voting behaviour of MPC members (described above) can be categorised as two static results (on average, internals vote for higher rates and their voting is more bunched), and a dynamic results (these average differences in behaviour are driven by external members changing their behaviour after a period on the MPC). While other papers have examined the voting behaviour of individual MPC members, and described similar static patterns, ours is the first to establish the dynamic one. Gerlach-Kristen (2003) looks at the basic descriptive data of MPC voting; Spencer (2007) focuses on the likelihood of a particular member dissenting from the group with their vote and finds, similarly to Gerlach-Kristen (2007), that

[7]This target changed from RPIX to the CPI measure of inflation in January 2004, with a reduction in the inflation target from 2.5% to 2%.

externals deviate more often; Bhattacharjee and Holly (2005, 2006) find evidence of heterogeneity in individual MPC members monetary policy reaction function. Harris and Spencer (2006), using an alternative econometric methodology to ours, find a similar static distinction between internals and externals voting patterns (internals vote more for on average higher rates and their voting is more bunched). Contrary this evidence of systematic differences between internal and external members, Besley et al (2007) find evidence of heterogeneity in voting behaviour, but they do not find evidence of systematic differences in the reaction to forecasts of inflation and the output gap between internal and external members (nor academic/non-academic, or those who previously worked in government policy).

Static heterogeneity alone is not especially surprising since members can have different views, although it is unclear why externals and internals have different views controlling for individual characteristics. The point is that the static results alone admit many explanations. However, our dynamic result is an especially interesting empirical puzzle, because our model shows that it is incompatible with an ideal voting model in which members have different views.

3 A Model of MPC Voting

In the universe of voting models one might want to test with MPC voting data, one clearly stands out: one in which members vote optimally from the government's perspective. As we have seen, the government gives members a clear mandate to focus on hitting the inflation target. So, in an ideal world, all members would seek to achieve this goal. Also, members would vote independently, without suppressing their views for whatever reason. We model exactly this situation in an environment where there is uncertainty both about future inflation, and about the correctness of each member's way of processing information. In our model, members will update their priors about both their own and other members approaches to interpreting the data and they can use these updated views to implement optimal policy (minimising the loss function from inflation deviations). We do not necessarily claim that our model describes actual voting behaviour, but rather provides a benchmark that we can use to judge the actions of committee members. While simple, the model provides enough predictions to enable us to use MPC voting data to examine whether observed behaviour is consistent with the government's ideal behaviour. In other words, if members were only trying to maximise welfare, the models tells us how they would behave as they learned new information. The key result of the model is that initial differences in opinion create voting heterogeneity not only initially, but throughout the voting process, while on the other hand, if members begin with no initial differences in philosophy, there will never be any differences in vote level.

3.1 Assumptions and Set-up

The first element of the model is a distribution $F_{\pi_{t+h}}$ for future inflation π_{t+h} conditional on the interest rate r_t and a stochastic state variable α_t that captures economic conditions at time t. The restrictions on F are that it satisfies $E[\pi_{t+h}] = g(r_t) + \alpha_t$ and $V[\pi_{t+h}] = \sigma_t^2 < \infty$. We assume that g is known and that $g'(r_t) < 0$ for all r_t. The t subscript refers to whatever point in time r_t must be chosen, while h is the horizon at which inflation is relevant for members choosing r_t. For example, on the MPC, members generally consider the two-year horizon for inflation when setting rates[8]. Assuming g is known while α_t is unknown implies that monetary policy experts in our set-up are certain of the monetary policy transmission mechanism, but unsure

[8] Of course, the concept of flexible inflation-targetting allows the monetary authority to vary h depending on the nature of the shock hitting the economy. In our model we focus on the fixed horizon of 2 years which dominates the discussion of policy making at the Bank of England.

about the inflationary pressures facing the economy. Thus everyone would agree that lowering interest rates from r_t^0 to r_t^1 will increase expected inflation by $f\left(r_t^1\right) - f\left(r_t^0\right)$ but not on the level of expected inflation at the new rate r_t^1. While one could certainly introduce uncertainty into some parameter of g, insider accounts suggest that in reality most disagreements on the MPC are about economic conditions rather than the transmission mechanism[9]. We take the state variable α_t to be a first order autoregressive process $\alpha_t = \rho\alpha_{t-1} + \varepsilon_t$ where $\varepsilon_t \sim N\left(0, \sigma_{\varepsilon t}^2\right)$ are unobserved shocks to the economy that impact on inflation.

We analyze a committee of two experts, although all results are directly generalizable to an N-person committee. In every time period t, each member i votes for an interest rate r_{it}^* that solves

$$\min_{r_{it}} E\left[\pi_{t+h} - \pi^* | I_{it}\right]^2 \tag{1}$$

where π^* is the inflation target and I_{it} is the information set of person i at period t. This objective function is close to that which the MPC members are instructed to consider according to the Bank of England Act - it focuses first and foremost on inflation stabilization around the target rate (as discussed above). An important assumption is that members do not condition their votes on others' voting behaviour; that is, we rule out strategic voting. Firstly, this provides analytical tractability since we avoid dealing with a game whose structure and solution would be quite complex. Secondly, the Bank directly encourages a one-person, one-vote philosophy. Thirdly, and perhaps most importantly, we cannot observe features of the voting process such as voting order (which varies from meeting to meeting) that would be important for estimating a strategic voting model.

In order to simplify later algebraic expressions, we make the non-essential assumption that members begin voting at $t = 1$ knowing that $\alpha_0 = 0$. Prior to voting in period t, member i observes a signal $\omega_{it} = \widehat{\varepsilon}_t + \theta_i$ where $\widehat{\varepsilon}_t = \varepsilon_t + v_t$ and $v_t \sim N\left(0, \sigma_{vt}^2\right)$ is independent across time periods and $\theta_i \sim N\left(\overline{\theta}_i, \sigma_{i\theta}^2\right)$ is independent across members. The two components of ω_{it} are meant to reflect the two main components of members' information sets. First, prior to voting members receive information from the data and from Bank staff on the state of the economy, which we capture with $\widehat{\varepsilon}_t$. All members share this component of ω_{it} in common. We define the total variance of $\widehat{\varepsilon}_t$ to be $\widehat{\sigma}_{\varepsilon t}^2$.

Second, members have individually-specific ways of interpreting the data to form a judgement about the magnitude of economic shocks. The member-specific parameter θ_i captures this process, and plays a crucial role in our model. We will refer to it as a member's *philosophy*. It reflects the way in which a member interprets data to form an opinion about the inflationary pressures that have developed between meetings. For example, it could capture a member's way of weighting different economic indicators, view about the supply gap in the economy, or simply a personal bias arising from a particular background like central banking, academia, or business. The fact that θ_i is stochastic (across members but not across time) implies that members are unsure about whether their philosophy is correct, and that they are willing to adjust it as they gain experience. However, we assume that member i believes $\theta_i \sim N\left(0, \sigma_{\theta i}^2\right)$, so that people enter the committee believing that their philosophy is correct, even though this belief could be incorrect[10].

Although we have ruled out strategic voting,[11] we do not exclude all interactions between

[9] See Barker (2007), for example. In addition Bhattacharjee and Holly (2005), who find heterogeneity in estimated individual policy reaction functions for MPC members, argue that differences in the way individual members assimilate information supplied to them generate such differences.

[10] Our model can easily account for perceived as well as unperceived biases. If member i believed that θ_i had a mean different from 0, then (s)he would simply adjust his signal downward accordingly.

[11] Bhattacharjee and Holly (2006) suggest that their results are evidence of strategic voting in the context of our model, their results could be explained by two members with similar philosophies

members. Indeed, there is ample time before voting for members to discuss and share their views on the economy. We model this by allowing each member's signal to be publicly observable by the other member. We assume that member i believes that $\theta_j \sim N\left(\overline{\theta}_j^i, \sigma_{i\theta}^2\right)$ where θ_j is the philosophy of member $j \neq i$. Thus, members can have incorrect, non-common priors on the correctness of any one individual's philosophy. However, we impose the natural belief restriction that $\overline{\theta}_j^i + \overline{\theta}_i^j = 0$ for $i = 1, 2$ and $j \neq i$. If member i thinks that member j sees the state of the world with a systematic upward bias of x, then member j thinks that member i sees the world with a systematic downward bias of x. In a sense, this assumption demands that the members' philosophical differences be coherent.

With the model fully described, one can now specify I_{it}. First, prior to voting members receive each other's signals, and know the distributions of the non-philosophical components of the signals, so that $\cup_{\tau=1}^{t} \{\omega_{1\tau}, \omega_{2\tau}, , \widehat{\sigma}_{\varepsilon\tau}\}$ is contained in I_{it}. Second, member i has initial beliefs on the distribution of his own and the other member's philosophies[12], so that his information set contains $\left\{\overline{\theta}_j^i; \sigma_{\theta 1}^2; \sigma_{\theta 2}^2\right\}$. Note that the members' information sets are identical except in their initial beliefs on the correctness of each other's philosophies.

3.2 Optimal voting behaviour

We now turn to the solution of (1).

Proposition 1 *r_{it}^* satisfies $g\left(r_{it}^*\right) + E\left[\alpha_t | I_{it}\right] = \pi^*$.*

Proof.

$$\begin{aligned} E\left[\pi_{t+h} - \pi^*\right]^2 &= E\left[\pi_{t+h}^2\right] - 2\pi^* E\left[\pi_{t+h}\right] + \left(\pi^*\right)^2 \\ &= V\left[\pi_{t+h}\right] + \left[E\left[\pi_{t+h}\right]\right]^2 - 2\pi^* E\left[\pi_{t+h}\right] + \left(\pi^*\right)^2 \\ &= V\left[\pi_{t+h}\right] + \left[E\left[\pi_{t+h}\right] - \pi^*\right]^2 \end{aligned}$$

By the law of iterated expectations

$$E\left[\pi_{t+h}\right] = E_{\alpha_t}\left[\pi_{t+h} | \alpha_t\right] = E_{\alpha_t}\left[\pi_{t+h} | \alpha_t\right] = g\left(r_t\right) + E\left[\alpha_t | I_{it}\right]$$

and by the law of iterated variances

$$V\left[\pi_{t+h}\right] = E\left[V\left[\pi_{t+h} | \alpha_t\right]\right] + V\left[E\left[\pi_{t+h} | \alpha_t\right]\right] = \sigma^2 + V\left[\alpha_t | I_{it}\right]$$

so member i picks r_{it} to minimize

$$\sigma^2 + V\left[\alpha_t | I_{it}\right] + \left[g\left(r_t\right) + E\left[\alpha_t | I_{it}\right] - \pi^*\right]^2$$

so r_{it}^* satisfies

$$2\left[g\left(r_{it}^*\right) + E\left[\alpha_t | I_{it}\right] - \pi^*\right] g'\left(r_{it}^*\right) = 0$$

which implies that $g\left(r_{it}^*\right) + E\left[\alpha_t | I_{it}\right] - \pi^* = 0$ since $g' < 0$ globally. The second order condition confirms that r_{it}^* is a minimum:

$$2g'\left(r_{it}^*\right) g'\left(r_{it}^*\right) + 2\left[g\left(r_{it}^*\right) + E\left[\alpha_t | I_{it}\right] - \pi^*\right] g''\left(r_{it}^*\right) = 2g'\left(r_{it}^*\right) g'\left(r_{it}^*\right) + 0 > 0$$

■

[12] Member i also has knowledge of the other member's beliefs about member i's philosophy, but this information is irrelevant for member i's voting behavior, hence we exclude it from I_{it}.

Both members agree on what the goal of the committee is–to meet the inflation target π^*–and they have at their disposal one instrument for achieving this–the interest rate. The above claim establishes the intuitive result that the optimal interest rate for each member is the one that sets the expected mean of the inflation distribution equal to the inflation target. This result holds for all distributions of inflation, not just symmetric ones. The only uncertain part of the expected mean is the current state of the economy, so the voting problem is equivalent to the problem of estimating current economic conditions, which by assumption is an aggregate of all economic shocks since the beginning of the committee. In algebra, $E[\alpha_t|I_{it}] = \sum_{\tau=1}^{\tau=t} \rho^{t-\tau} E[\varepsilon_\tau|I_{it}]$. Therefore, all voting differences between members arise as differences in the estimation of economic shocks.

3.3 Voting heterogeneity

In this section, we explore the sources of voting heterogeneity among members. Given that the only differences among members are in initial disagreements in monetary policy philosophies, a natural starting point is to explore the effect of these differences on voting behaviour. The following proposition formalizes the impact of philosophical disagreements on voting behaviour. The proof proceeds via three claims, with the economic intuition of the results provided after the proofs.

Proposition 2 *If* $\overline{\theta}_2^1 = -\overline{\theta}_1^2 \neq 0$ *then* $r_{1t}^* \neq r_{2t}^* \ \forall t$. *Moreover, if* $r_{1t'}^* \neq r_{2t'}^*$ *for some* t' *then* $\overline{\theta}_2^1 = -\overline{\theta}_1^2 \neq 0$.

Claim 3 *if* $(x_1, .., x_n)'$ *are random variables with a joint normal distribution with mean vector* $(\mu_1, ..., \mu_n)'$ *and covariance matrix* $\Sigma = \begin{bmatrix} \Sigma_{11} & \Sigma_{12} \\ \Sigma_{21} & \Sigma_{12} \end{bmatrix}$ *where* Σ_{11} *is the variance of* x_1 *and* Σ_{22} *is covariance matrix of* $(x_2, .., x_n)'$, *etc., then* $x_1 | \{x_j\}_{j=2}^n \sim N(\mu, \sigma^2)$ *where*

$$\mu = \mu_1 + \Sigma_{12}\Sigma_{22}^{-1}\left[(x_2, .., x_n)' - (\mu_2, .., \mu_n)'\right]$$

and

$$\sigma^2 = \Sigma_{11} - \Sigma_{12}\Sigma_{12}^{-1}\Sigma_{21}$$

Proof. See Greene (2008), pages 871-2. ■

Claim 4

$$E[\alpha_t|I_{1t}] - E[\alpha_t|I_{2t}] = \sum_{\tau=1}^{\tau=t} \rho^{t-\tau} \begin{pmatrix} \beta_{1\tau}\left(E[\theta_1|I_{2t}\backslash\{w_{1\tau}, w_{2\tau}\}] - E[\theta_1|I_{1t}\backslash\{w_{1\tau}, w_{2\tau}\}]\right) \\ +\beta_{2\tau}\left(E[\theta_2|I_{2t}\backslash\{w_{1\tau}, w_{2\tau}\}] - E[\theta_2|I_{1t}\backslash\{w_{1\tau}, w_{2\tau}\}]\right) \end{pmatrix} \quad (2)$$

where

$$\beta_{i\tau} = \frac{\sigma_{\varepsilon\tau}^2\left(\widehat{\sigma}_{\varepsilon\tau}^2\right)^{-1}\left(V[\theta_i|I_{1t}\backslash\{w_{1\tau}, w_{2\tau}\}]\right)^{-1}}{\left(\widehat{\sigma}_{\varepsilon\tau}^2\right)^{-1} + \left(V[\theta_1|I_{1t}\backslash\{w_{1\tau}, w_{2\tau}\}]\right)^{-1} + \left(V[\theta_2|I_{1t}\backslash\{w_{1\tau}, w_{2\tau}\}]\right)^{-1}}$$

Proof. Consider the problem of estimating $E[\varepsilon_\tau|I_{1t}]$. Because $I_{1t}\backslash\{w_{1\tau}, w_{2\tau}\}$ is only correlated with ε_τ via correlation with θ_1 and θ_2, estimating $E[\varepsilon_\tau|I_{1t}]$ is equivalent to estimating $E[\varepsilon_\tau|w_{1\tau}, w_{2\tau}]$ given $\theta_1 \sim N\left({}_{t\backslash\tau}\mu_{1,t\backslash\tau}^1\, \sigma_1^2\right)$ and $\theta_2 \sim N\left({}_{t\backslash\tau}\mu_{2,t\backslash\tau}^1\, \sigma_2^2\right)$ where ${}_{t\backslash\tau}\mu_1^1 = E[\theta_1|I_{2t}\backslash\{w_{1\tau}, w_{2\tau}\}]$

and ${}_{t\backslash\tau}\sigma_1^2 = V\left[\theta_1 | I_{1t}\backslash\{w_{1\tau}, w_{2\tau}\}\right]$ and likewise for ${}_{t\backslash\tau}\mu_2^1$ and ${}_{t\backslash\tau}\sigma_2^2$. By Claim 3 we have that

$$\begin{aligned} E\left[\varepsilon_\tau | I_{1t}\right] &= \frac{\sigma_{\varepsilon\tau}^2 \left(\widehat{\sigma}_{\varepsilon\tau}^2\right)^{-1} \left({}_{t\backslash\tau}\sigma_1^2\right)^{-1}}{\left(\widehat{\sigma}_{\varepsilon\tau}^2\right)^{-1} + \left({}_{t\backslash\tau}\sigma_1^2\right)^{-1} + \left({}_{t\backslash\tau}\sigma_2^2\right)^{-1}} \left(\omega_{1\tau} - {}_{t\backslash\tau}\mu_1^1\right) + \\ & \frac{\sigma_{\varepsilon\tau}^2 \left(\widehat{\sigma}_{\varepsilon\tau}^2\right)^{-1} \left({}_{t\backslash\tau}\sigma_2^2\right)^{-1}}{\left(\widehat{\sigma}_{\varepsilon\tau}^2\right)^{-1} + \left({}_{t\backslash\tau}\sigma_1^2\right)^{-1} + \left({}_{t\backslash\tau}\sigma_2^2\right)^{-1}} \left(\omega_{2\tau} - {}_{t\backslash\tau}\mu_2^1\right) \end{aligned}$$

The result follows directly. ■

Claim 5 *For* $1 \leq \tau \leq t$ *and* $i = 1, 2$, $E\left[\theta_i | I_{2t}\backslash\{w_{1\tau}, w_{2\tau}\}\right] - E\left[\theta_i | I_{1t}\backslash\{w_{1\tau}, w_{2\tau}\}\right] = \alpha\left(\theta_i^2 - \theta_i^1\right)$ *where* $0 < \alpha \leq 1$.

Proof. We proceed by induction to show that $E\left[\theta_1 | I_{2t}\backslash\{w_{11}, w_{21}\}\right] - E\left[\theta_1 | I_{1t}\backslash\{w_{11}, w_{21}\}\right] = \alpha\left(\overline{\theta}_1^2 - \overline{\theta}_1^1\right)$ for all t where $0 < \alpha \leq 1$. For $t = 1$ we have

$$E\left[\theta_1 | I_{21}\backslash\{w_{11}, w_{21}\}\right] - E\left[\theta_1 | I_{11}\backslash\{w_{11}, w_{21}\}\right] = \overline{\theta}_1^2 - \overline{\theta}_1^1.$$

By the inductive hypothesis suppose that ${}_{t-1\backslash 1}\mu_1^2 - {}_{t-1\backslash 1}\mu_1^1 = \alpha\left(\overline{\theta}_1^2 - \overline{\theta}_1^1\right)$ and that ${}_{t-1\backslash 1}\mu_2^2 - {}_{t-1\backslash 1}\mu_2^1 = \alpha'\left(\overline{\theta}_2^2 - \overline{\theta}_2^1\right)$ for some $0 < \alpha, \alpha' \leq 1$. Now consider $E\left[\theta_1 | I_{2t}\backslash\{w_{11}, w_{21}\}\right]$. Because the random variables ω_{1t} and ω_{2t} are independent of those in $I_{2t-1}\backslash\{w_{11}, w_{21}\}$ conditional on θ, one can take $f\left(\theta_1 | I_{2t-1}\backslash\{w_{11}, w_{21}\}\right)$ as the prior distribution of θ_1 for person 2 and only use ω_{1t} and ω_{2t} to estimate $E\left[\theta_1 | I_{2t}\backslash\{w_{11}, w_{21}\}\right]$. By Claim 3, therefore

$$\begin{aligned} E\left[\theta_1 | I_{2t}\backslash\{w_{11}, w_{21}\}\right] &= {}_{t-1\backslash 1}\mu_1^2 + \frac{\left(\widehat{\sigma}_{\varepsilon t}^2\right)^{-1} + \left({}_{t-1\backslash 1}\sigma_2^2\right)^{-1}}{\left(\widehat{\sigma}_{\varepsilon t}^2\right)^{-1} + \left({}_{t-1\backslash 1}\sigma_1^2\right)^{-1} + \left({}_{t-1\backslash 1}\sigma_2^2\right)^{-1}} \left(\omega_{1t} - {}_{t-1\backslash 1}\mu_1^2\right) \\ & - \frac{\left({}_{t-1\backslash 1}\sigma_2^2\right)^{-1}}{\left(\widehat{\sigma}_{\varepsilon t}^2\right)^{-1} + \left({}_{t-1\backslash 1}\sigma_1^2\right)^{-1} + \left({}_{t-1\backslash 1}\sigma_2^2\right)^{-1}} \left(\omega_{2t} - {}_{t-1\backslash 1}\mu_2^2\right) \end{aligned}$$

so that

$$\begin{aligned} & E\left[\theta_1 | I_{2t}\backslash\{w_{11}, w_{21}\}\right] - E\left[\theta_1 | I_{1t}\backslash\{w_{11}, w_{21}\}\right] \\ = & \left[1 - \frac{\left(\widehat{\sigma}_{\varepsilon t}^2\right)^{-1} + \left({}_{t-1\backslash 1}\sigma_2^2\right)^{-1}}{\left(\widehat{\sigma}_{\varepsilon t}^2\right)^{-1} + \left({}_{t-1\backslash 1}\sigma_1^2\right)^{-1} + \left({}_{t-1\backslash 1}\sigma_2^2\right)^{-1}}\right] \alpha\left(\overline{\theta}_1^2 - \overline{\theta}_1^1\right) \\ & + \left[\frac{\left({}_{t-1\backslash 1}\sigma_2^2\right)^{-1}}{\left(\widehat{\sigma}_{\varepsilon t}^2\right)^{-1} + \left({}_{t-1\backslash 1}\sigma_1^2\right)^{-1} + \left({}_{t-1\backslash 1}\sigma_2^2\right)^{-1}}\right] \alpha'\left(\overline{\theta}_2^2 - \overline{\theta}_2^1\right) \\ = & \overline{\theta}_1^2 \left[\begin{array}{c} \alpha\left(1 - \frac{\left(\widehat{\sigma}_{\varepsilon t}^2\right)^{-1} + \left({}_{t-1\backslash 1}\sigma_2^2\right)^{-1}}{\left(\widehat{\sigma}_{\varepsilon t}^2\right)^{-1} + \left({}_{t-1\backslash 1}\sigma_1^2\right)^{-1} + \left({}_{t-1\backslash 1}\sigma_2^2\right)^{-1}}\right) \\ + \alpha' \frac{\left({}_{t-1\backslash 1}\sigma_2^2\right)^{-1}}{\left(\widehat{\sigma}_{\varepsilon t}^2\right)^{-1} + \left({}_{t-1\backslash 1}\sigma_1^2\right)^{-1} + \left({}_{t-1\backslash 1}\sigma_2^2\right)^{-1}} \end{array}\right] \end{aligned}$$

where we have used the fact that $\overline{\theta}_1^1 = \overline{\theta}_2^2 = 0$ and $\overline{\theta}_1^2 = -\overline{\theta}_2^1$. One can verify that the term in brackets is between 0 and 1 given that α and α' are as well. This completes the proof for the case of $i = 1$ and $\tau = 1$. The rest of the cases work in identical fashion. ■

Proof. (of Proposition 2). Combining Claims 4 and 5 gives the result. ■

The main result of Proposition 2 is that initial differences in opinion create voting heterogeneity not only initially, but throughout the voting process. Although members adjust their philosophies as they gather more information from the Bank and from each other, they never attain full agreement in finite time if there is initial disagreement. On the other hand, however, if members begin with no initial differences in philosophy, there will never be any differences in vote level. This quite strong result could be relaxed if we allowed some imperfect communication of signals, in which case there would be no differences in expected vote level rather than actual vote level. However, the result that groups with no systematic divergence in initial voting should show no systematic divergence in later voting actually holds in more general frameworks as well, for example one in which members receive a person specific shock in their signal.

From Claim 3, one can see that member 1's estimate of ε_t given I_{1t} is simply a weighted average of the elements of the information set, so that

$$E\left[\varepsilon_t | I_{1t}\right] = \delta_{11}\left(\omega_{11} - \overline{\theta}_1^1\right) + \delta_{21}\left(\omega_{21} - \overline{\theta}_2^1\right) + ... + \delta_{1t}\left(\omega_{1t} - \overline{\theta}_1^1\right) + \delta_{2t}\left(\omega_{2t} - \overline{\theta}_2^1\right)$$

where the weights δ_{it} come from inverting the covariance matrix of the vector

$$\left(\omega_{11}, \omega_{21}, ..., \omega_{1t}, \omega_{2t}\right)'.$$

Because there is common knowledge of the variance elements of their signals, members 1 and 2 agree on the weights. The only scope for disagreement comes from the priors they have on the means of each other's signals. If they are in agreement about these, then in every time period their estimates of the economic shocks will be exactly equal.

Corollary 6 *Heterogeneity in the precision of different members signals does not generate heterogeneity in voting behaviour of members.*

Suppose member 1 has a very large $\sigma_{\theta 1}^2$ compared to $\sigma_{\theta 2}^2$ and $\widehat{\sigma}_{\varepsilon 1}^2$, and that $\overline{\theta}_1^2 = \overline{\theta}_2^1 = 0$. This means that the $\delta_{1\tau}$ will be much smaller than $\delta_{2\tau}$ for any time period τ; since the informational content of person 1's signal is much less than that of person 2's, it has less influence in estimation. Now, suppose we hold $\sigma_{\theta 2}^2$ and $\widehat{\sigma}_{\varepsilon 1}^2$ fixed in this setting, but replace $\sigma_{\theta 1}^2$ with $\widetilde{\sigma}_{\theta 1}^2 < \sigma_{\theta 2}^2$, so that now person 1's signal is more precise than person 2's. The effect is that $\delta_{1\tau}$ will be larger than $\delta_{2\tau}$ for any time period τ. But as long as $\overline{\theta}_1^2 = \overline{\theta}_2^1 = 0$, the voting levels of the members will not diverge.

This example shows that the results in the empirical section cannot arise from a model in which new external members follow the majority because they initially lack confidence, but later break away from the more experienced central bankers as they clarify their views and gain more confidence; in an ideal world, the unsure MPC member best serves society by revealing his or her less precise signal and allowing other, more precise views to have a larger weight in his or her final decision. If members vote the same initially, it is because they have a similar view on the world; even if one member is extremely firm in his beliefs, and the other is shaky, as long as they agree on them, they will not begin to disagree at some later point.

3.4 From Theory to Data

Our model characterizes voting behaviour with two moments: mean and variance. Accordingly, we can use data on the voting records of MPC members to explore patterns in voting levels and

dispersion. However, any results on member differences will not shed light on the validity of our model, as these are exactly the kinds of difference it admits. The predictions on the time path of disagreement does provide a clear way to possibly reject our model. If members start voting for similar interest rates and continue to do so forever, or if members vote for different interest rates initially and gradually coverage, we cannot reject our model; if they do not do either, then we can. The value added of our model is thus the ability to not only describe differences in voting behaviour, but to identify what can and cannot underlie them.

4 Econometric Analysis

4.1 Data

We use a complete history of MPC voting records between July 1997 and August 2007 (data available from the Bank of England website). This contains a record of every decision ($decision_t$) taken by the MPC, as well as each member's vote ($vote_{it} = \Delta r_{i,t}$). Before June 1998 there is information about whether members preferred higher or lower interest rates compared with the decision, but not about their actual preferred rate. In these cases, we treat a member's vote as either 25 basis points higher or lower than the decision, in the direction of disagreement. The Bank website also provides information on which members were external appointments and which were internal. For every member we gathered biographical information, including previous occupation, educational background, and age from press releases associated with their appointment and from their returns to the Treasury Select Committee ahead of their confirmation.

For technical reasons, we drop the emergency meeting held after September 11th from our dataset, but since this meeting was unanimous in its decision (to lower interest rates) it would not be used for econometric identification in any case given our use of time fixed effects. Howard Davies served on the MPC for the first 2 meetings and is the only member who voted exclusively on unanimous committees and thus his inclusion/exclusion is unimportant for econometric identification; we include him in our baseline regressions. Lord George, the Governor in the majority of our sample, always voted with the majority regardless of his starting position; as a result we think that these voting records do not represent his own views in all cases. Even under the governorship of Mervyn King, the Governor has only deviated twice since taking office in July 2003. Nonetheless, we include the observations for the Governor in the regression results presented below, though all of the results stand if we exclude the data on the Governor at each meeting.

In Table 1 we provide summary statistics of the individual members on the MPC. Of the 25 MPC members that we consider in our sample, 14 are external and 11 are internal as indicated by the variable[13]:

$$INT_i = \begin{cases} 0 \text{ if member } i \text{ is an external member} \\ 1 \text{ if member } i \text{ is an internal member} \end{cases}$$

The average vote shows the mean of all votes cast by the member during their time on the MPC within our sample; this is obviously driven largely by when a member served their time on the committee. The variance column reports the analogous 2nd moment for the voting data. Table 1 shows that the educational background of both groups is mixed (a similar dispersion exists if we look at previous career background, and whether each member worked as an academic prior to their appointment ($acad_i = 1$). It is also clear from Table 1 that each group contains members who deviate more and less often from the majority. However, the tendency is clearly for external

[13] No member has so far served as both an external member and an internal member, though there is nothing that prohibits this from happening in the future.

members to deviate more often than internal members, and for them to vote for a rate lower than the majority (with the notable exceptions of Sentance and Besley). Differences along these lines have already by pointed out in Gerlach-Kristen (2003). One of the goals of this paper is to establish whether they stand up to formal econometric testing, controlling for observable variables.

That there are numerous disagreements within the MPC is not surprising given the uncertainties involved in setting interest rates. Although only 14% of total votes casts differ from the majority of votes casts that period, 64% of the 122 meetings in our sample have at least 1 deviation. Figure 1 shows the level of interest rate chosen by the MPC, where the + signs that are off the main line indicate deviations from the majority. These deviations occur regularly and not just around turning points in the interest rate cycle.

As noted in the theory section, the dependent variables of interest are voting levels and dispersion. To measure the latter there are numerous options, including the squared deviation from the average vote in each time period $(\Delta r_{i,t} - \overline{\Delta r_t})^2$, squared deviation from the committee's decision $(\Delta r_{i,t} - \Delta r_t^{dec})^2$, or the squared deviation from the average external or internal vote $(\Delta r_{i,t} - \overline{\Delta r_t}^{group})^2$. All of these measure the dispersion of member i from the group, thereby capturing the underlying variance of his voting behaviour. In practice, these three measures are highly correlated (with correlation coefficients above 0.9), so although we use the first measure in our main regressions, replacing it with either of the others would not change our results.

4.2 Econometric Model

While Table 1 suggests that the external members deviate from the committee more often, and are more volatile in their voting behaviour, it is clear that these unconditional statistics do not properly account for the fact that members serve their terms at different times during which more or less deviations may take place. In order to establish the behaviour of voting in a more robust way, we move to a regression framework. A key element in our model is the use of time fixed-effects. Therefore we estimate the model in equation (3) using OLS[14].

$$y_{it} = \alpha + \beta.age_{it} + \lambda.z_i + \theta.INT_i + \tau.Time_t + \chi.Q_t + \varepsilon_{it} \tag{3}$$

where:

- y_{it} is the outcome variable of interest;
- age_{it} is the age of member i at time t;
- z_i are time-invariant individual characteristics;
- INT_i is the internal dummy variable defined earlier;
- $Time_t$ is a dummy variable which is 1 in period t and zero otherwise (month fixed effect);
- Q_t is a quarterly dummy which takes the value 1 for each of the 3 months within each particular quarter, and zero otherwise.

The implication of the inclusion of these dummies is the elimination of any variables that vary only across time and not across individuals (z_t), and it ensures that identification in this equation comes from those months in which there was a deviation by at least one member of

[14] Although our data is categorical (in 25bp devisions) we proceed using OLS. Use of multinomial logit estimation is not feasible with 7 distinct groupings in our sample (and theoretically more).

the MPC. An alternative was to include data on inflation and GDP, as well as the information that comes from Bank of England quarterly forecast meetings as controls; this approach does not alter the conclusions of our work. These time effects are necessary to control for the business cycle and other economic trends that affect voting behaviour.

We do not include member fixed effects because the variable of interest in (3) is the internal dummy, which is a time-invariant individual characteristic. Fixed effects would not allow estimation of the θ coefficient since it does not vary through time. However, in the regressions in which we interact INT_i with a time-varying dummy we do show that our results are robust to the inclusion of member fixed effects[15]. As a further robustness check, we also include a committee composition dummies in some regressions[16]; in other words, for each unique collection of committee members we create a dummy variable, and include this set of variables as a control. This is potentially important if a member's vote is affected by the identity of the other committee members.

We allow the errors to be clustered by MPC member; it is unlikely that members' errors are independent across time periods, especially if there is some systemic heterogeneity in the voting rules that members use. Clustering corrects the standard errors of the estimates for this correlation making it less likely that we wrongly fail to reject a null hypothesis of coefficient significance. However, we also show that our results are unchanged without the clustering option.

To measure the effect of being an internal versus being an external on voting behaviour, we need to ensure that the variable of interest is not capturing the effects of another variable which is correlated the INT dummy variable. As a result we include a set of controls for obvious confounders. The regressions include controls for those who were from the private sector (early career control), education, and age, in addition to the INT dummy variable. Education is one if the member has a master's degree or PhD and zero otherwise (the effect of the two kinds of degrees was similar in the regressions, so we combine them). Of course, there could still be member heterogeneity that these biographical variables do not capture. However, given that any study that attempts to estimate the effect of being an external member in a regression framework cannot use member fixed effects, one can never be one hundred per cent sure of the consistency of the OLS estimates. If the regressors are independent of the error term, then the OLS estimates from equation (3) will be consistently estimated.

4.3 Results

4.3.1 Static voting patterns

The regressions using $vote_{it}(= \Delta r_{i,t})$ as the dependent variable are reported in Table 2. In column (1), only time fixed-effects and the INT_i variables are included, with standard errors clustered on members; it is clear that internal members vote on average for higher interest rates (+3.5bps). This result is robust to the inclusion of quarter fixed-effects (Column (2)) and committee fixed-effects (Column (3)). In Column (4) we include a number of the other regressors such as the members age, whether they were previously academics, and their education; none of these are statistically significant, although the coefficient on the variable of interest drops slightly (+2.8bps) but remains significant at the 5% level. As expected, not taking account of

[15] An alternative to this approach is to use fixed effects in the regressions, and then to examine the whether the estimated fixed effects are correlated within particular groups.

[16] Committee fixed effects require inclusion of a seperate 0-1 dummy variable for every different committee composition that has met. Therefore, if a member leaves the committee and is replaced by a new member, this represents a new committee composition and so a new dummy variable. Also, if a member is absent and so only 8 members meet in a particular month, then this committee composition is also different and so controlled for seperately.

the clustered errors compresses the standard errors, although there is no change in the estimated coefficients (Column (5)).

This difference is considerable. Consider the counterfactual of switching an average external member for an average internal member and holding other factors equal. Given the convention of expressing votes in 25 basis point increments, the swing member will vote for no change if $\widehat{r} - 12.5 < r^* \leq \widehat{r} + 12.5$, a raise of 25 basis points if $\widehat{r} + 12.5 < r^* \leq \widehat{r} + 37.5$, etc. This would mean that the internal vote would, ceteris paribus, be for higher interest rates 11% more of the time[17].

Table 3 examines the dispersion of these votes within time periods. We repeat the analysis of the above 2 paragraphs using $(\Delta r_{i,t} - \overline{\Delta r_t})^2$ as the dependent variable measuring vote heterogeneity (although we exclude the results without clustering in the interests of space). Both age and the higher education are statistically significant; older members in general vote in a more tightly packed bunch, while members with postgraduate degrees deviate further from the group mean than do their less educated counterparts. In this case however we find that the group of internals vote more like the average of the committee. This is not capturing the fact that externals deviate more often; as a group they deviate more often but also in a more dispersed manner. To assess the magnitude of this effect, consider Column (4) of Table 3: the average deviation in the committee is 0.008 (it is small because it is a measure of variance), and the effect of being internal is to reduce this deviation by 0.005, or by 70%.

4.3.2 Dynamic voting patterns

Our regressions so far indicate that being an external or internal member matters for voting levels and variance, not because of any education, age, or career differences, but because of some other factor specific to being external or internal. While one might wonder why being an external or internal should matter for one's vote, these finding alone do not allow us to comment on the validity of our voting model. In order to test it, we need to establish what is the time trend of voting behaviour; that is, whether there are initial disagreements maintained through time, or whether some group breaks away from another at some stage. To do this, we introduce a dummy variable measuring experience:

$$\exp_{it} \begin{cases} = 0 \text{ if the member is in their first 12 months on the committee} \\ = 1 \text{ otherwise} \end{cases}$$

In Table 4 we present the regression results from the following equation:

$$y_{it} = \alpha + \beta.age_{it} + \lambda.z_i + \theta_1.INT_i + \theta_2.\exp_{it} + \theta_3.(INT_i.\exp_{it}) + \tau.Time_t + \chi.Q_t + \varepsilon_{it} \quad (4)$$

In Columns (1) and (2), we simply add the experience variable as an additional control to our previous regressions; in both cases, the experience variable is statistically significant. Experience is associated with a lower level of vote and more dispersion. But in both cases, the effect of being an internal member is unchanged. To see whether experience influences the voting behaviour of internals and externals in different ways, we next include interaction terms in our original regressions. These are reported in Columns (3) - (6); in the last 2 columns we include member fixed effects[18]. In column (7) we replicate the fixed-effects regressions of column (6),

[17] This assumes that the true desired interest rate is continuously distributed so that when the interest rate that the external votes for is 10bps (no change given 25bp convention), the internal would vote for 10+2.8bps which is a 25bp change. The figure of 11% follows from $\left[\frac{2.8}{25}\right]$.

[18] In the fixed effects regressions, we exclude the age variable as it becomes a person specific trend when it is de-meaned. However, the results are qualitatively and quantitatively similar with its inclusion.

but use as the dependent variable the squared deviation of each members vote from their group (internal/external) mean vote for period t.

The results in terms of voting levels are striking. In Column (3) the effect of being an internal is no longer significant, but the effect of being experienced is highly significant and large in magnitude (-6 bps lower on average). Moreover, the coefficient on the interaction term is also large in magnitude ($+6$ bps higher on average) and highly significant; thus, the effect of experience is different for internals and externals. Experience by itself leads people to vote for lower rates, but this is driven entirely by the external members; it is not possible to reject the hypothesis that internal members do not change their vote once they become experienced. It therefore seems that neither inexperienced nor experienced internals vote for different rates on average. This implies that although inexperienced externals do not behave any differently than inexperienced internals, experienced externals vote for systematically lower interest rates on average. This finding is also robust to fixed effects panel data estimation, although the magnitude and significance of the coefficient on experience is reduced (Column (5)).

Of course the choice of 12 months is rather arbitrary; we have repeated the analysis using alternative measures such as 6, 9 and 18 month dummy variables, as well as a trending variable over the first 12 months[19]. In fact, though the use of a 9 month dummy is most significant, we feel that 12 months is less arbitrary - $\frac{1}{3}$ of the term for non-Governor-internal and external members.

In addition, this result is not driven by the first year of the MPC process (when everyone was new). Repeating the regression in Columns (3) and (5), but dropping the first 2 years of MPC meetings, yields the same results.

To summarize, we find that:

1. External members vote for, on average, lower interest rates;
2. and external members votes are more dispersed than those of internals.
3. The voting level differences are driven entirely by experienced external members - when they first start on the MPC, external and internal votes are statistically the same.

5 Discussion

5.1 Consistency with ideal behaviour

Our findings that external members are more dovish and more dispersed compared with internals is established more robustly than in previous literature, but taken by themselves they are not enough to comment one way or the other on what drives voting behaviour. However, our third finding is much more useful for distinguishing among theoretical possibilities. In particular, we can use it to reject the model of ideal voting behaviour presented above. If one assumes that members are behaving according to the government's wishes, the fact that new externals and internals come into the committee and vote for statistically equivalent interest rates means they have equal priors on the bias of each other's signal. Exposure to increasing amounts of information should not drive Bayesian agents apart, and yet our econometric results show that after being on the committee for some given amount of time, externals separate from internals and vote for systematically lower interest rates. Moreover, our model is merely illustrative; we believe that any reasonable model with Bayesian learning and ideal behaviour assumptions could not explain the patterns in the data. This finding is quite important because it indicates the

[19] Results available on request.

presence of an agency problem on the MPC. Experts make interest rate decisions on behalf of the government, but at least the current structure of the MPC does not commit members to use their information to maximize the government's objective function. Our results show evidence that members indeed do not do so, resulting in a welfare loss to the government.

One can also evaluate whether the observed results are consistent with the model's predictions on voting variability. As members form more and more precise estimates of their bias, their voting should become less variable. Columns (2) and (6) might at first glance appear to present another violation of ideal behaviour voting model, since experience is associated with greater variability in voting behaviour. At this point, however, our choice of $(\Delta r_{i,t} - \overline{\Delta r_t})^2$ as the measure of voting heterogeneity becomes problematic. Since we have established that externals and internals begin voting for similar interest rates and then diverge from each other, experience will create a higher average deviation from the committee mean even if neither internals nor externals become more variable in their voting. In order to address this concern, we rerun the regression of column (6) (Table 4) using $(\Delta r_{i,t} - \overline{\Delta r_t}^{group})^2$ as the dependent variable and report the results in columns (7)[20]. In column (7), the coefficient on the experienced dummy is insignificantly different from zero (indicating that experience does not affect the variance of external members around their group mean). Moreover, the sum of the experienced and interaction dummies (though positive) is insignificant (p-value 0.175); this provides evidence that internals do not in fact become less variable as a group with experience.

Thus there is little evidence that voting becomes less variable with experience. There are two ways to interpret this result. First, it could be further evidence that voting behaviour is not consistent with ideal behaviour if members fail to refine their views on the state of the world. A second possibility, however, is that there are other factors besides uncertainty on θ terms that create voting heterogeneity, such as member and time specific noise in observed signals, or noise in the communication process. If this noise is persistent, then our econometric model might not identify learning effects if they are masked by the other sources of noise. At the very least one can conclude that learning is not an important element in influencing voting heterogeneity.

5.2 Signalling

If we are going to reject the model of ideal voting behaviour, a natural question to ask is what model we need to use in its place. A related issue is whether internals or externals (or both) are the group whose voting diverges from ideal behaviour. One possibility is that members not only want to maximize (1), but also want to signal their competence or preferences through their voting record. In other words, committee members may have career concerns. For example, internals may want to signal to the government and to the central banking community that they are tough inflation fighters. Externals, who face more uncertainty about their future prospects after their terms end, may want to signal to future employers that they are competent economists, or that they have business friendly views. This section examines the credibility of these stories.

To test whether signalling drives the divergence in voting levels between externals and internals that arises with experience, a natural approach is to divide internals and externals, respectively, into groups for which reputational considerations should play varying roles and to see whether these different groups display the same divergence as they gain experience[21]. If they do, then signalling is not a convincing factor in explaining our results, while if they don't, it cannot be ruled out. We consider two partitions of internals and externals into groups with

[20] Repeating the results for column (4) using $(\Delta r_{i,t} - \overline{\Delta r_t}^{group})^2$ as the dependent variable yields similar conclusions.

[21] We have also carried out the same analysis for the variance of voting behaviour; these results are not included as the variance results are less puzzling than the level results, but are available on request.

varying career concerns. First, among internals and externals there are substantial numbers of academics and non-academics. Because of the tenure system, one could argue that academics should have less of a need to signal since they have a stronger outside option should they fail to build a good reputation. In order to test whether non-academics and academics differ in voting behaviour, we run the following regression:

$$\begin{aligned} y_{it} &= \alpha + \beta.age_{it} + \lambda.z_i + \theta_1.INT_i + \theta_2.\exp_{it} + \theta_3.(INT_i.\exp_{it}) + \theta_4.Acad_i \\ &\quad + \theta_5.(Acad_i.\exp_{it}) + \theta_6.(Acad_i.INT_i) + \tau.Time_t + \chi.Q_t + \varepsilon_{it}. \end{aligned} \tag{5}$$

Rather than discuss the values of the coefficients themselves, which are presented in Table 5 (column (1) without fixed effect, and column (2) with fixed effects), it is easier to discuss the sums that represent the total effect of taking on a particular set of characteristics. For example, the total effect of being an internal, experienced non-academic is $\theta_1 + \theta_2 + \theta_3$ and the effect of being an experienced, external academic is $\theta_2 + \theta_4 + \theta_5$. The relevant sums are listed in the coefficient column of Table 6; the other columns give information on testing whether these sums are significantly different from 0. Of course, what we are interested in is not whether these sums are significantly different from 0, but whether academics and non-academics have a similar time path of votes. To this end, we test whether (1)=(2)=(3)=(4)=(5)=(6) in Table 6 and find that one cannot reject this hypothesis ($F(5, 23) = 0.43$, $Prob > F = 0.8260$). On the other hand, one can reject (1)=(2)=(3)=(4)=(5)=(6)=(7)=(8) ($F(7, 23) = 5.99$, $Prob > F = 0.0005$) but not (7)=(8) ($F(7, 23) = 5.99$, $Prob > F = 0.0005$). These results imply that all internals and inexperienced externals vote for statistically equivalent interest rates regardless of having previously been academics or not. Furthermore, academic and non-academic experienced externals do not vote for significantly different interest rates, but they do vote for significantly lower rates than other committee members.

One could of course argue that academics also have career concerns if they want future policy roles, and that non-academics can also return to their previous jobs after their terms end since time on the MPC presumably only boosts one's credibility in whatever profession one used to work. We therefore present another test of career concerns. The Act that created the MPC allows for the reappointment of all members, internal and external. When the first group of externals and internals served on the MPC, they thus operated under the assumption that reappointment to the committee was possible, although uncertainty still existed about how the reappointment system would function. Then, on 18 January 2000, Willem Buiter wrote an open letter to then Chancellor Gordon Brown that laid down forceful arguments for not reappointing external members (Buiter, 2000). Whether or not this letter swayed Brown's decision is unclear, but he did not reappoint a single external member from the original group, even though some were still among the most prominent monetary policy experts in the UK. A clear precedent was set: external members would find reappointment difficult, most likely extremely so. All external members served for only one term until February 2003 (almost 6 years since the first MPC meeting), when Brown unexpectedly reappointed Stephen Nickell to the MPC (HM Treasury, 2003). Since then, Kate Barker has also been reappointed twice.

If career concerns existed, one would expect different voting patterns between external members serving from February 2000 to February 2003 and those serving at other times, since the rewards to reputation presumably changed when reappointment was and was not possible. To this end, we run the regression

$$\begin{aligned} y_{it} &= \alpha + \beta.age_{it} + \lambda.z_i + \theta_1.INT_i + \theta_2.\exp_{it} + \theta_3.(INT_i.\exp_{it}) + \theta_4.reappoint_{it} \\ &\quad + \theta_5.(reappoint_{it}.\exp_{it}) + \theta_6.(reappoint_{it}.INT_i) + \tau.Time_t + \chi.Q_t + \varepsilon_{it}, \end{aligned} \tag{6}$$

where $reappoint_{it}$ equals 1 for all internals, and for externals before February 2000 and after February 2003; the results are reported in Table 5 (columns (3) and (4)). Again, sums of coefficients are more interesting then their raw values, and we report them in Table 7. As the $reappoint_{it}$ variable is picking up a time effect (the tendency for higher rates during the three years between February 2000 and February 2003), the relevant test is whether the difference between (5) and (7) differs from the difference between (6) and (8); that is, whether experienced externals separate from internals whether or not they can be reappointed to the committee. In fact, the difference in differences is insignificant ($F(1,23) = 0.65, Prob > F = 0.4294$) which again undermines the plausibility of career concerns.

Due to space constraints, we omit two other tests of career concerns we conducted, although they are worth mentioning. Although understanding the time path of votes in a career concerns model would require an explicit model, a distinct possibility is that behaviour would not be constant through time. One might expect reputation to become more relevant as the end of one's tenure approached. To test this idea, we ran a regression that replaced $reappoint_{it}$ in the above regression with $near\_end\_term_{it}$ that took the value 1 if committee member i was within 6 months of ending his or her term at time t. Again, this variable added nothing to the explanatory power of regression (4). Also, we separated out members by whether they served 3-year or 5-year terms (the latter group comprises the governor and deputy governors and the former everyone else), and again found no significance differences.

Taken together, these results suggest that career concerns do not play a large role in MPC voting (though they obviously cannot disprove the existence of career concerns). This finding is of independent interest because papers such as Levy (2007) and Sibert (2003) have stressed the theoretical consequences of career concerns in committee voting, and Meade and Stasavage (2008) have uncovered patterns in the voting record of the FOMC that they interpret as identifying career concerns. These papers largely focus on voting differences when deliberation and voting is transparent or secretive, a dimension on which we do not observe variation. Nevertheless, the regressions in this section show that career concerns are not always present or are present but muted. They also show that understanding when career concerns do and do not arise is an important topic for further research.

5.3 Implications for Committee Design

Although we have not reached a conclusion about the correct model that underlies voting patterns, our results do have clear implications for anyone charged with designing a monetary policy committee. First, there are measurable differences in the behaviour of internal and external members, meaning that the inclusion of both on a committee has statistically significant effects. If we had found no differences between the groups, then the decision of whether or not to include external members would perhaps not even be relevant. However as differences do exist, this is not a trivial matter[22].

Second, the fact that the government's objective function, in our model, is concave means that the extra variability in the voting behaviour of external strictly lower social welfare; if externals voted for the same average interest rate but with less dispersion government welfare would strictly increase. Hence, at least in the context of our model, the only justification for including external members must come from their choosing interest rates more accurately than internal members.

[22] One caveat applies to our econometric results. Because we have not explicitly modelled (correctly) the behavior of internals and externals, using our regression output to draw counterfactual conclusions is not justified. Replacing the four external members with internal members in any given meeting might change the behavior of the original five internal members, depending on the nature of the equilibrium that prevails.

Finally, governments should not assume that committee members behave optimally. According to our results, one can unambiguously reject a model in which all members optimally aggregate information in order to maximize a quadratic loss function.

Of course, there are likely to be only three experienced external members on the MPC, and so the likelihood that their lower votes actually cause the outcome of the MPC meeting to change is small. Nonetheless, Gerlach-Kristen (2004) shows that markets observe, and react to, the MPC voting record, and members' dissenting in the direction of lower rates can lower the yield curve even if they do not swing the majority of committee members. Whether this lowering leads to higher output and inflation is subject to debate. Moreover, the welfare implications of such outcomes is also not straightforward; for example, where the central bank is using equation (1) as its loss function, but where social welfare also includes an output loss term[23], lower interest rates without a knock-on effect on inflation or inflation expectations might actually boost welfare.

Our results also show that herding does not arise in an environment in which experts take decisions sequentially. Scharfstein and Stein (1990), Banerjee (1992), and Ottaviani and Sorenson (2000) have shown that when experts have private signals about the state of the world and take decisions one after the other, then in equilibrium experts can "herd," or ignore their private information and follow those that voted before them, either because of reputational or optimal decision making preferences. If anything, our results show the opposite. MPC members begin with no disagreement whatsoever, and then after several rounds of voting begin to disagree. A tempting explanation is that for some reason new members suppress their private information, but then after time begin expressing themselves. If this were the case, a herding situation would occur before experts had any access to others' views, but then disappear once they did, in direct contradiction to the aforementioned theoretical literature[24] [25].

6 Conclusion

We have presented evidence of substantial behavioural differences between external and internal members of the MPC which suggests that at least one of the groups behaves in a suboptimal way from the government's perspective. This systematic difference between internals and externals should be particularly surprising given the use of individual fixed-effects and given the fact that internals are often appointed from very similar backgrounds to externals and, therefore, the two groups differ only in the sense that the internals are appointed to the staff of the Bank of England and take on management responsibility.

In considering the advantages of external MPC members for the committee, our paper leaves one major avenue unexplored. Though we focused on information in our paper, we have not modelled explicitly a heterogeneous information processing and sharing approach. Perhaps external members, with different perspectives, change the way internal members consider some issues or interpret some of the data. For example, if the signals that members received were multidimensional, and externals brought more precise information to the committee on certain dimensions, then including them on the committee could increase government welfare even if externals were

[23] This world where the Central Bank only cares about inflation is an extreme conservative central banker in the world of Rogoff (1985).

[24] The voting sequence is from meeting to meeting, and in our model experts' signals about the period t shock were not correlated with their signals about the period $t+1$ shock, so in fact herding or anti-herding would never occur anyway. We could, however, have introduced correlation in the shocks without altering the results, and in this case our model would be one in which herding could occur.

[25] If experts do indeed hide their private information upon first joining the committee, then allowing new members to serve an apprenticeship during which they can learn about the MPC process without having to vote for interest rates would be advisable, since supression of private information lowers social welfare.

no more likely to vote for the correct interest rate than internals. This is consistent with official views about the committee structure[26]. Further research might address this topic.

Future research should also try to determine exactly what drives MPC voting behaviour established in this paper in order to answer the question of whether or not external members should have places on monetary policy committees. Similar work on the voting behaviour of other central bank committees with published voting records may also contribute to the understanding of this issue.

Nonetheless, this paper has provided a first step in this direction and has established an important, and puzzling, set of robust facts on the voting behaviour of the external members of the MPC; they appear to initially behave like hard-nosed, inflation fighting central bankers and then, over time, vote for lower interest rates. The next step is to establish whether such 'delayed dovishness' is a desirable feature of independent monetary policymakers.

[26] Two quotes from the Bank of England website capture these views:

> "The desirability of having independent voices on the committee suggests that while professional economists should have a strong representation, it is a good idea to have a number of members with a different point of view. This helps to ensure that decision-making is not dominated by a rigid consensus perspective."
>
> "The appointment of external members is designed to ensure that the MPC benefits from thinking and expertise in addition to that gained inside the Bank of England."

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Table 1: Sample Statistics by Member

Member	**INT**$_i$	**Average Vote**	**Variance of Vote**	**Education**	**Acad**$_i$	**Meetings**	**Total Deviations**	**% Deviations**
Andrew Sentance	0	0.18	0.014	Prof/PhD	0	11	4	36.4
Charles Goodhart	0	0.01	0.050	Prof/PhD	1	35	3	8.6
Christopher Allsopp	0	-0.13	0.020	Masters/Accountancy	1	36	10	27.8
David Blanchflower	0	0.00	0.009	Prof/PhD	1	15	5	33.3
David Walton	0	0.00	0.023	Masters/Accountancy	0	12	3	25.0
DeAnne Julius	0	-0.12	0.036	Prof/PhD	0	45	13	28.9
Kate Barker	0	0.00	0.020	Undergraduate	0	75	5	6.7
Marian Bell	0	-0.01	0.018	Masters/Accountancy	0	36	5	13.9
Richard Lambert	0	0.02	0.013	Undergraduate	0	34	0	0.0
Sir Alan Budd	0	-0.06	0.070	Prof/PhD	0	18	4	22.2
Stephen Nickell	0	-0.05	0.028	Prof/PhD	1	72	17	23.6
Sushil Wadhwani	0	-0.11	0.041	Prof/PhD	0	36	12	33.3
Tim Besley	0	0.17	0.015	Prof/PhD	1	12	4	33.3
Willem Buiter	0	0.00	0.106	Prof/PhD	1	35	16	45.7
Charles Bean	1	-0.02	0.017	Prof/PhD	1	83	5	6.0
David Clementi	1	-0.04	0.034	Masters/Accountancy	0	60	4	6.7
Ian Plenderleith	1	-0.03	0.033	Masters/Accountancy	0	59	5	8.5
John Vickers	1	0.00	0.060	Prof/PhD	1	28	5	17.9
Mervyn King	1	0.02	0.027	Prof/PhD	0	122	14	11.5
Paul Tucker	1	0.05	0.012	Undergraduate	0	63	7	11.1
Rachel Lomax	1	0.04	0.008	Masters/Accountancy	0	50	5	10.0
Sir Andrew Large	1	0.07	0.016	Masters/Accountancy	0	40	9	22.5
Sir Edward George	1	-0.03	0.029	Undergraduate	0	72	0	0.0
Sir John Gieve	1	0.08	0.014	Undergraduate	0	19	1	5.3
Howard Davies	1	0.25	0.000	Masters/Accountancy	0	2	0	0.0

Table 2: Regressions of MPC Voting Behaviour

	(1) $vote_{it}$	(2) $vote_{it}$	(3) $vote_{it}$	(4) $vote_{it}$	(5) $vote_{it}$
INT_i	0.035**	0.035**	0.035**	0.028**	0.028***
	(0.013)	(0.013)	(0.013)	(0.013)	(0.006)
D(high education)				-0.011	-0.011*
				(0.014)	(0.006)
D(private sector)				-0.018	-0.018**
				(0.014)	(0.007)
Age				-0.000	-0.000
				(0.001)	(0.000)
Month FE?	Yes	Yes	Yes	Yes	Yes
Quarter FE?		Yes	Yes	Yes	Yes
Committee FE?			Yes	Yes	Yes
Clustered Residuals?	Yes	Yes	Yes	Yes	No
Constant	0.229***	0.229***	0.120**	0.249***	0.249***
	(0.013)	(0.013)	(0.049)	(0.040)	(0.044)
Observations	1068	1068	1068	1068	1068
R^2	0.79	0.79	0.79	0.79	0.79

Robust standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

Table 3: Regressions of MPC Voting Behaviour - Variance of Votes

	(1) $(\Delta r_{i,t} - \overline{\Delta r_t})^2$	(2) $(\Delta r_{i,t} - \overline{\Delta r_t})^2$	(3) $(\Delta r_{i,t} - \overline{\Delta r_t})^2$	(4) $(\Delta r_{i,t} - \overline{\Delta r_t})^2$
INT_i	-0.005**	-0.005**	-0.005**	-0.005***
	(0.002)	(0.002)	(0.002)	(0.002)
D(high education)				0.004**
				(0.002)
D(private sector)				-0.001
				(0.002)
Age				-0.000
				(0.000)
Month FE?	Yes	Yes	Yes	Yes
Quarter FE?		Yes	Yes	Yes
Committee FE?			Yes	Yes
Clustered Residuals?	Yes	Yes	Yes	Yes
Constant	0.003*	0.003*	-0.009	0.008
	(0.002)	(0.002)	(0.009)	(0.005)
Observations	1068	1068	1068	1068
R^2	0.20	0.20	0.20	0.22

Robust standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

Table 4: Experience Regressions

	(1) $vote_{it}$	(2) $(\Delta r_{i,t} - \overline{\Delta r_t})^2$	(3) $vote_{it}$	(4) $(\Delta r_{i,t} - \overline{\Delta r_t})^2$	(5) $vote_{it}$	(6) $(\Delta r_{i,t} - \overline{\Delta r_t})^2$	(7) $(\Delta r_{i,t} - \overline{\Delta r_t}^{group})^2$
INT_i	0.033**	-0.005***	-0.009	-0.006**	-	-	-
	(0.013)	(0.002)	(0.019)	(0.002)	(-)	(-)	(-)
D(high education)	-0.013	0.005**	-0.015	0.005**	-	-	-
	(0.013)	(0.002)	(0.014)	(0.002)	(-)	(-)	(-)
D(private sector)	-0.017	-0.001	-0.017	-0.001	-	-	-
	(0.013)	(0.002)	(0.013)	(0.002)	(-)	(-)	(-)
Age	0.000	-0.000*	0.000	-0.000*			
	(0.001)	(0.000)	(0.001)	(0.000)			
$\exp_{it}$	-0.033**	0.003*	-0.058***	0.002	-0.029***	0.003*	-0.002
	(0.014)	(0.002)	(0.018)	(0.002)	(0.010)	(0.002)	(0.001)
INT_i*$\exp_{it}$			0.057***	0.001	0.044***	0.001	0.004**
			(0.017)	(0.003)	(0.012)	(0.002)	(0.002)
Month FE?	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Quarter FE?	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Committee FE?	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Clustered Residuals?	Yes	Yes	Yes	Yes			
Member FE?					Yes	Yes	Yes
Constant	0.230***	0.009*	0.260***	0.009*	1.610***	0.018	0.003
	(0.039)	(0.005)	(0.040)	(0.005)	(0.255)	(0.043)	(0.034)
Observations	1068	1068	1068	1068	1068	1068	1068
R^2	0.80	0.23	0.80	0.23	0.81	0.20	0.21

Robust standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

Table 5: Signalling Regression Results

	(1) $vote_{it}$	(2) $vote_{it}$	(5) $vote_{it}$	(6) $vote_{it}$
INT_i	-0.010	-	0.022	-
	(0.025)	-	(0.022)	-
$\exp_{it}$	-0.042**	-0.011	-0.068***	-0.043***
	(0.020)	(0.012)	(0.019)	(0.013)
acad_i	0.012	-		
	(0.038)	-		
$reappoint_{it}$			0.228***	0.153***
			(0.042)	(0.039)
INT_i*$\exp_{it}$	0.048***	0.035***	0.053***	0.041***
	(0.017)	(0.013)	(0.017)	(0.012)
INT_i*acad_i	0.005	0.000		
	(0.028)	(0.000)		
$\exp_{it}$*acad_i	-0.037	-0.042***		
	(0.026)	(0.015)		
INT_i*$reappoint_{it}$			-0.041**	-0.009
			(0.017)	(0.013)
$\exp_{it}$*$reappoint_{it}$			0.019	0.028
			(0.023)	(0.017)
Constant	0.253***	1.596***	0.061	1.521***
	(0.047)	(0.254)	(0.049)	(0.262)
Observations	1068	1068	1068	1068
R-squared	0.80	0.82	0.80	0.81
# of members		24		24
Member FE?	NO	YES	NO	YES

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1
All regressions include Month, Quarter and Committee FE

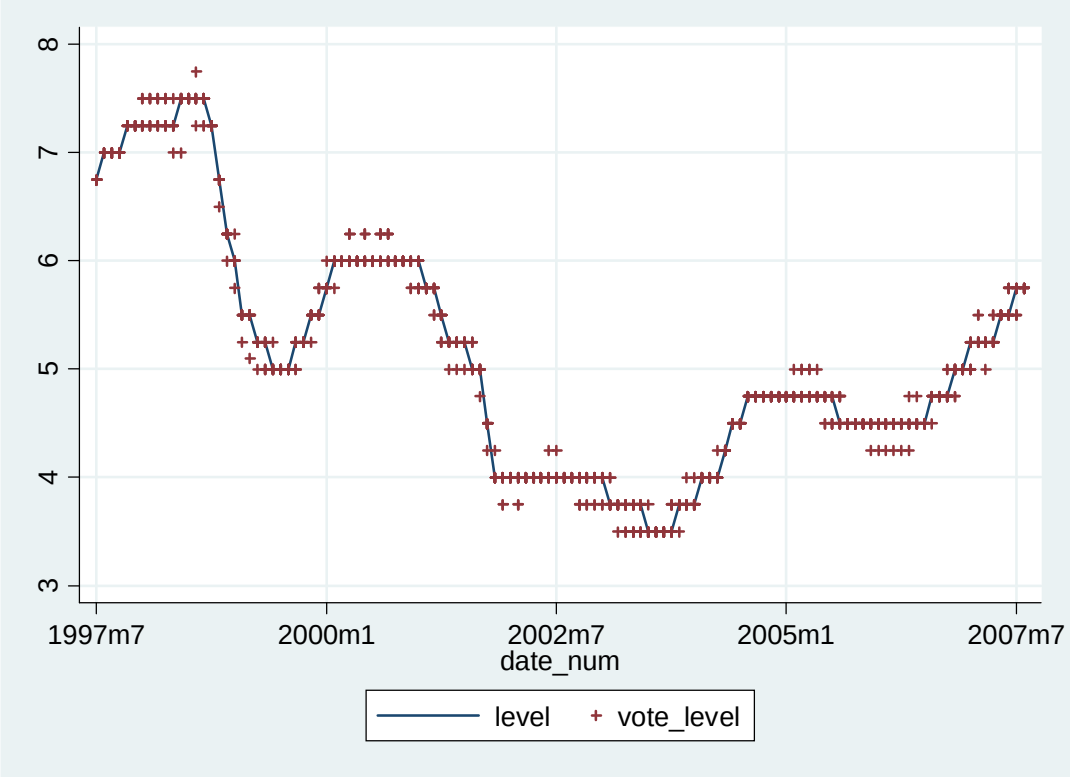
Table 6: Academic and Experience Regressions - Main Coefficients

Column	Members	Coefficient	Std. Error	T-test	P-Value
	Internals				
(1)	New, non-academic	-0.010	0.025	-0.430	0.674
(2)	New, academic	0.001	0.057	0.020	0.983
(3)	Experienced, non-academic	-0.004	0.025	-0.180	0.862
(4)	Experienced, academic	-0.025	0.029	-0.850	0.404
	Externals				
(5)	New, non-academic		Baseline case		
(6)	New, academic	0.012	0.038	0.310	0.760
(7)	Experienced, non-academic	-0.042	0.020	-2.080	0.049
(8)	Experienced, academic	-0.067	0.030	-2.200	0.038

Table 7: Possible Reappointment and Experience Regressions - Main Coefficients

Column	Members	Coefficient	Std. Error	T-test	P-Value
	Internals				
(1)	New, non-reappoint	0.022	0.022	1.000	0.328
(2)	New, reappoint	0.209	0.034	6.210	0.000
(3)	Experienced, non-reappoint	0.007	0.023	0.290	0.775
(4)	Experienced, reappoint	0.213	0.037	5.720	0.000
	Externals				
(5)	New, non-reappoint		Baseline case		
(6)	New, reappoint	0.228	0.042	5.480	0.000
(7)	Experienced, non-reappoint	-0.068	0.019	-3.620	0.001
(8)	Experienced, reappoint	0.179	0.039	4.530	0.000

Figure 1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