Communicating Monetary Policy when the MPC Members Believe in Different Stories

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Abstract

Most central banks provide the public with information about the reasoning behind a specific interest rate decision, that is, a 'story'. When decisions are made by a committee, it can be problematic to find a story that is both consistent with the decision and representative for the committee. The paper goes through different alternatives of finding a consistent story. We show that the only alternatives that give unique and consistent stories are: (i) vote on the interest rate and let the winner decide the story, (ii) vote on the elements of the story and let the interest rate follow from the story. The two procedures tend to give different interest rate decisions and different stories, due to an aggregation inconsistency known as the "discursive dilemma". We investigate the quality of the stories under the two approaches, and find that alternative (ii) gives stories that tend to be closer to the true, but unobservable, story. Thus, our results give an argument in favour of premise-based, as opposed to conclusion-based, decision-making. The paper also discusses institutional devices that support premise-based decisionmaking, such as a core forecasting model and an inflation report "owned" by the MPC.

Keywords: Monetary policy committees, Communication, Judgment aggregation, Discursive dilemma

JEL Classification: E52, E58, D71

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1 Introduction

Most central banks today aim at being transparent. One feature of transparency is that the central banks also communicate why they reached the particular interest rate decision, for example, by statements, inflation reports and press conferences. In other words, transparent central banks communicate actual decisions *and* the story behind it. But what if the members of the monetary policy committee (MPC) believe in different stories? Ideally, the MPC members should spend sufficient time on discussions and analyses to reach agreement. But in practice, we do observe that there is disagreement about the interest rate decision, which could reflect that there is disagreement about the story. We see disagreement in individualistic committees, like the MPC of Bank of England,[1] but it would be naive to think that similar disagreement does not also exist in collectivistic consensus-oriented committees too, althoug they stand unified behind the chosen decision and story.

We assume that the central bank does not reveal all the individual stories, but rather presents a single story, which represents the MPC's (aggregate) judgments. We do not attempt to model why the central bank does not reveal all individual stories, and there is an unsettled issue whether central banks should do so.[2] Many central banker would, however, probably endorse the following statement of Blinder (2007): "*A central bank that speaks with a cacophony of voices may, in effect, have no voice at all.*"

In this paper we analyse the following questions: How can the MPC find a story that is consistent with the interest decision? Which alternative for chosing stories (and interest rate decisions) is the best? How can the best procedure be attained in practice?

To illustrate the relevance of the two first questions, suppose for simplicity that all MPC members agree to set the interest rate according to the Taylor rule, i.e.

$$i_t = r_t^* + \pi^* + 1.5(\pi_t - \pi^*) + 0.5y_t, \qquad (1)$$

where i_t is the nominal interest rate, r_t^* is the neutral real interest rate, π^* is the desired rate of inflation (inflation target), π_t is actual inflation, and y_t is the output gap. The neutral real interest rate r_t^* and the output gap y_t are uncertain, particularly in real time, and the MPC members must use judgment to quantify them. Suppose that π_t can be perfectly observed, and assume for simplicity that inflation is on target, $\pi_t = \pi^* = 2$. The MPC members' judgments (estimates) on r_t^* and y_t are as in Table 1. Suppose further that the MPC aggregates judgments by majority voting, and let the

[1] For the first five years of the MPC of Bank of England, 106 out of 642 votes cast were dissenting Spencer (2005).

[2] One might interpret the Minutes of the MCP of Bank of England as a publications that partly reveals the individual stories.

Table 1:

	Story		Interest rate
	r_t^*	y_t	i_t
Members 1 - 3	2.0	1.0	4.5
Members 4 - 6	2.5	0.0	5.0
Members 7 - 9	2.0	0.0	4.0
Majority	2.0	0.0	4.5

outcome of voting be the median of the individual estimates. When voting on the interest rate, the result is $i_t = 4.5$. The majority *story* is, however, $[r_t^* = 2.0,\ y_t = 0]$ which is not consistent with $i_t = 4.5$. How can the MPC arrive at interest rate decisions and consistent stories? In the paper we analyse four alternatives for reaching a story when the committee has voted on the interest rate. We find that only one of these is able to produce a complete and consistent story. This is the 'conclusion-based procedure', where the MPC's story is the story of the member(s) who won the vote in the interest rate. In the example this is the story of member $1-3$, i.e. $[r_t^* = 2.0,\ y_t = 1.0]$. We then show that an alternative decisionmaking procedure is the 'premise-based procedure', where the members vote on r_t^* and y_t separately and then let the interest rate decision follow from the Taylor rule. This gives unique stories and consistency. In the case of the example, the interest rate decision under the premise-based procedure is $i_t = 4.0$, and the story is $[r_t^* = 2.0,\ y_t = 0]$.

The premise- and the conclusion-based procedures tend to give different interest rates and different stories, as the example illustrates. The MPC faces a dilemma. Which procedure should they use? We argue that the MPC should use a the premise-based procedure. The argument is based on two findings. First, a premise-based procedure tend to give better interest rate decisions than the conclusion-based procedure (see Claussen & Røisland (2007a)). Second, we find that a story consistent with a premise-based procedure is superior to a story consistent with a conclusion-based procedure in terms of reducing the root mean square error of the judments. Thus, if the accuracy of the public information is welfare improving, our results suggest that decisions and communication should be based on a premise-based procedure.

We then discuss institutional and practical implications of our results. We suggest that important tools to achieve premise-based decisions are a *core forecasting model* which reflects the MPC members' aggregate views on the main economic mechanisms, and an *inflation report*, which reflects the MPC members aggregate judgments on the state and likely development of the economy. If these devices are 'owned' by the MPC, the core model could be interpreted as the MPC's aggregate judgment on the transmission mechanism, and the inflation report as the aggregate judgments of the state-variables.

The inconsistencies in the example illustrates a general inconsistency-problem arising when aggregating judgments. This type of aggregation inconsistency is sometimes referred to as the 'discursive dilemma', see e.g. Pettit (2001). It is another type of aggregation inconsistency problem than the inconsistency summarised by Arrow's famous impossibility theorem. The inconsistency arises because of the connection between the premises (the story) and the conclusion. It is a general problem that arises for any democratic aggregation method and for almost any connection between variables, see e.g. Claussen and Røisland (2005, 2007b) and Dietrich (2006). We are not aware of any contributions in the literature on MPC's or judgment aggregation (see e.g. Dietrich (2007) and references therein) that analyse the implications of the two decision procedures for the quality of a group's 'story'.

The paper is organized as follows. In section 2 we present the general model and analyse the alternative ways to find a story. In section 3 we investigate the quality of information of the stories under the relevant alternatives. In section 4 we discuss institutional and practical implications of our findings. We conclude by section 5.

2 Consistent communication

In this section we will analyse analytically how and when an MPC can find a story that is consistent with its interest rate decision.

2.1 The model

An MPC with n members has two tasks; to decide the interest rate and to provide a 'story' that explains the decision. The members agree that the appropriate interest rate i should depend on the estimates ('judgments') of k *premise-variables* $p_1, p_2, ..., p_k$. The premise-variables could be variables like inflation, output gap, etc, and parameters like elasticities, slope of Philips curves, etc. The members agree that the dependence between the premise-variables and the interest rate is given by the *decision rule*

$$i = f(p_1, p_2, ..., p_k). \tag{2}$$

Note that the decision rule does not imply that the members agree on the same reaction function. To see this, consider the simple Taylor type reaction function $i = g(\pi, y) = a\pi + by$, where π is inflation and y is the output gap. The arguments in the reaction function are π and y. If all MPC members always agree on the coefficients a and b, but not on the values of π and y, then the decision rule is equal to the reaction function. If they always agree on the values of π, but not on the appropriate response to inflation a, the decision rule is $i = f(a, y)$, while π enters through the functional form of $f(\cdot)$. Thus, if the MPC members disagree about the parameters in the reaction function, then the parameters enter as premise-variables in the decision rule.

A *story* S is a vector of estimates of the k premise-variables, i.e.,

$$S = (p'_1, p'_2, ..., p'_k),$$

where p'_j is a given value of premise-variable p_j. We will assume that the premise-variables are continuous variables. Let $\boldsymbol{S}$ be the set of possible stories, i.e. the domain of $f(\cdot)$. We say that an estimate ('judgment') of the interest rate is consistent with a story if it follows from the story and the decision rule.

Definition 1 *An interest rate i' is consistent with story S' if*

$$i' = f(S'). \tag{3}$$

We denote the members' stories $S_1, ..., S_n$ where $S_j = (p_{1,j}, p_{2,j}, ..., p_{k,j})$ and $S_j \in \boldsymbol{S}$ for all $j \in \{1, ..., n\}$. We assume that each member's preffered interest rate i_j is consistent with his story, i.e.,

$$i_j = f(S_j), \tag{4}$$

for all $j \in \{1, 2, ..., n\}$. The members' stories should be understood as representing the members judgments after they have discussed and shared information. In the first stage of an MPC meeting the MPC members share information and update the estimates. But this does not make the judgments perfectly alligned.

We denote the MPC's story S_{mpc} where $S_{mpc} = (p_{1,mpc}, p_{2,mpc}, ..., p_{k,mpc})$. The MPC's interest rate decision is denoted i_{mpc}. The MPC's task is then to aggregate the individual stories $S_1, ..., S_n$ into an aggregate story S_{mpc}, and the individual interest rate suggestions $i_1, ..., i_n$ into an aggregate decision i_{mpc} such that

$$i_{mpc} = f(S_{mpc}).$$

Generally, groups may aggregate in many ways. Here we will focus on majority voting. This simplifies the analysis, but our main arguments hold for a much wider class of non-dictatorial aggregation methods. Majority voting is not always capable of selecting a uniqe (Condorcet) winner. However, from the median voter theorem we know that if the preferences over the alternative values for a variable are single peaked, the median estimate is the Condorcet winner. We therefore assume that the members' preferences for each variable (including the interest rate) are single peaked. For monetary policy decisions this is a reasonable assumption. Denote the median of $i_1, ..., i_n$ by i_m and the median of $p_{i,1}, ..., p_{i,n}$ by $p_{i,m}$. The members may also perform a pairwise majority vote over the alternative stories $S_1, ..., S_n$. Denote the outcome of this vote – if it exsists – by S_m.

2.2 Choosing the story for a given interest rate

We will first look at the case when the MPC votes on the interest rate, which results in the median interest rate, i.e., $i_{mpc} = i_m$. How can they arrive at a consistent and unique story supporting this decision? We will consider 4 alternatives and ask which of these that always give a unique story that is consistent with the interest rate.[3]

The first alternative is to vote on stories. One might suspect that since the preferences over the premise-variables are single peaked, voting on the stories will always give a Condorcet winner. But this is not the case. To see this, suppose that there are two premise-variables, i.e., $k = 2$, and three MPC members; $n = 3$. Let there be three alternatives for each premise-variable, (p_1', p_1'', p_1''') and (p_2', p_2'', p_2'''), such that $p_1' < p_1'' < p_1'''$ and $p_2' < p_2'' < p_2'''$. Let the preferences on the premise-variables be the following: Member 1: $p_1' \succcurlyeq p_1'' \succcurlyeq p_1'''$, $p_2'' \succcurlyeq p_2' \succcurlyeq p_2'''$, Member 2: $p_1'' \succcurlyeq p_1' \succcurlyeq p_1'''$, $p_2''' \succcurlyeq p_2'' \succcurlyeq p_2'$, and Member 3: $p_1''' \succcurlyeq p_1'' \succcurlyeq p_1'$, $p_2' \succcurlyeq p_2'' \succcurlyeq p_2'''$. The stories are then $S_1 = (p_1', p_2'')$, $S_2 = (p_1'', p_2''')$, and $S_3 = (p_1''', p_2')$. A combination of (possible) preferences over these stories is then

$$\begin{array}{ll} \text{Member 1:} & S_1 \succcurlyeq S_3 \succcurlyeq S_2, \\ \text{Member 2:} & S_2 \succcurlyeq S_1 \succcurlyeq S_3, \\ \text{Member 3:} & S_3 \succcurlyeq S_2 \succcurlyeq S_1. \end{array}$$

With these preferences no story beats the two other alternative stories in a pairwise vote. Thus, in this example majority voting is not capable of producing a Condorcet winner even though the preferences over each variable are single peaked. More generally, we have the following result, which says that if there are more than one premise-variable, voting on the stories will sometimes not give a unique story.

Proposition 1 *If $k = 1$ there is a unique Condorcet winner for all $(S_1, ...S_n) \subseteq \boldsymbol{S}^n$. If $k > 1$ there are $(S_1, ...S_n) \subseteq \boldsymbol{S}^n$ with no unique Condorcet winner.*

Proof. The first part follows from single peaked preferences over the premise-variable(s), the second part follows from the example above. ■

An alternative to vote on the stories is to vote on each premise-variable separately and then let the story be the outcome of these votes. The problem with this method is that it will generally not produce a story that is consistent with the interest rate. The example in the introduction gives an illustration. More generally we have the result in Proposition 2, which says that if there are more premise-variables, or if the decision rule is non-monotonic, voting on the premise-variables will sometimes give a story that

[3] There is in principle an infinite number of ways to choose the story, but we find these 4 to be the most realistic ones. Furthermore we *believe* the other methods will not give unique or consistent stories.

is inconsistent with the interest rate decision. Claussen & Røisland (2007a) shows that such inconsistencies are very likely to occur in monetary policy. Let $S_{p_m} = (p_{1,m}, ..., p_{k,m})$. Then,

Proposition 2 *$i_m = f(S_{p_m})$ for all $(S_1, ..., S_n) \subseteq \boldsymbol{S}^n$ if and only if $k = 1$ and $f(S)$ is monotonic.*

Proof. Claussen & Røisland (2007b). ■

A third alternative for arriving at a story is to start with the interest rate i_{mpc} and the decision rule $f(S)$ and then pick the story among the stories $S_1, ..., S_n$ which gives consistency. The problem with this alternative is that it will not always give a unique story. Suppose, for instance, that the decision rule is $i = p_1 + p_2$ and the members stories are $S_1 = (1, 3), S_2 = (3, 1)$, $S_3 = (2, 2)$. In this case $i_{mpc} = 4$, and there are three alternative stories, all consistent with the decision rule. More generally we have the result in Proposition 3 which says that that if there are more than one premise-variable or if the decision rule is non-monotonic, the median interest rate and the decision rule will sometimes not give a unique story.[4] For the proposition, let $S_{f^-(i_m)}$ be a story that follows from the decision rule and i_m. Then,[5]

Proposition 3 *There is a $(S_1, ...S_n) \subseteq \boldsymbol{S}^n$ with no unique $S_{f^-(i_m)}$ if and only if either $k > 1$, or $k = 1$ and $f(S)$ is non-monotonic over $\boldsymbol{S}$.*

Proof. Straight forward. ■

Notice, however, that with continuous variables and less than perfectly correlated individual judgments, the probability of two different stories in $(S_1, ..., S_n)$ giving the same interest rate is zero. In that case, this method will produce a unique story, and the method will in be the same as using the winner's story (see below). However, if the variables are discrete, Proposition 3 is relevant.

The fourth alternative is to let the median voter on i decide the story. Let i_m be the median of $(\dot{i}_1, ..., i_n)$. Denote the story of the median voter on i by S_{i_m}. Since we have imposed consistency in individual stories we have the following proposition which states that this method will always give a unique and consistent story:

[4]Note also that the conditions for consistency of a story based on voting on each premise-variable is identical to the conditions for the existence of only one consistent story. Although these results are not completely unrelated, this equivalence in conditions is not general. For example, if the MPC aggregates judgments by a linear aggregator (e.g., the mean) in stead for by majority voting, the conditions for consistency becomes different (Claussen & Røisland (2007b)), while the conditions for uniqueness remain the same. Furthermore, if the variables are not continous variables the conditions are not the same.

[5]If the variables are discrete there is always a unique S for each i if the decision rule is monotonic such that each i correspnds to exactly one $S \in \boldsymbol{S}$.

Proposition 4 *$i_m = f(S_m)$ for all $(S_1, ..., S_n) \subseteq \boldsymbol{S}^n$.*

Proof. Follows from (4). $\blacksquare$

Monetary policy decisions will typically rely on judgments on more than one premise-variable. Our results for the case when $k > 1$ is summarised in Table 2. We can conclude that if the monetary policy decisions are based on judgments of more than two premise-variables, only alternative 4 ensures a unique story that is consistent with the interest rate that follows from majority voting over the alternatives $i_1, ..., i_n$.

Table 2: Features of alternative methods for arriving at stories for a given interest rate when there are two or more premise variables

Alternatives	Unique story?	Consistency?
1: Voting on stories	No	No
2: Voting on premise-variables	Yes	No
3: Decision function	No	Yes
4: Winner's story	Yes	Yes

2.3 Choosing the interest rate for a given story

Some MPCs vote on the interest rate. Other MPCs seem to have more consensus- or premise-based decisions. How can the MPC in our model find a story without first having decided the interest rate? From the discussion in section 2.2 above, we know that voting on stories will sometimes not give a unique story. Thus, if the MPC has not arrived at an i_{mpc} we are left with one alternative, namely to vote on each premise-variable.

What are the alternatives for choosing an interest rate when the MPC has chosen the story S_{p_m}? From proposition 2 it follows that if $k > 1$ or $k = 1$ and $f(S)$ is monotonic, the only alternative that always gives consistency is to let the interest rate follow from the story and the decision rule, i.e. $i_{mpc} = f(S_{p_m})$.

2.4 The discursive dilemma

The discussion above implies that the MPC is left with two alternatives. With a *conclusion-based procedure*, the MPC votes directly on the interest rate and lets the story be the one that 'belongs' to the winner of the vote on the interest rate. With a *premise-based procedure*, the MPC first votes on the premise-variables and then let the interest rate decision follow from the voting results and the decision rule. However, since the premise-based and the conclusion-based procedure tends to give different policy decisions (c.f Proposition 2, and the results in Claussen & Røisland (2007a)), the MPC faces a (discursive) dilemma: Which decision procedure should it use?

Claussen & Røisland (2007a) analyse which of the two decision procedures that gives the better monetary policy decisions. For linear decision rules, they find that they are normatively equal. If the MPC disagrees about the slope of the Phillips curve or the interest rate elasticity, which enter non-monotonically in the decision rule, a premise-based procedure tends to give better decisions. We will in the next section give yet another argument for the premise-based procedure. The argument is based on the fact that a consistent story accompanying a conclusion-based decision tends to be different from a consistent story accompanying a premise-based decision.

3 Truth-tracking

In the previous section, we assumed that MPC's task was to come up with an interest rate decision and a story behind it. We did not provide an explanation for *why* the MPC should present a story in addition to deciding the interest rate. There can be many arguments for communicating a story. First, one may argue that being transparent about its judgments is important for reasons of democratic accountability.[6] Second, presenting a story might be an indirect way for the MPC to give a signal of future interest rate decisions. Third, there can be asymmetric information between the MPC and the private agents, such that the MPC's story has informational value. We will focus on the last reason. Without modelling asymmetric information explicitly, we assume that the story has informational value, and we will analyse the quality of the information content in S_{i_m} and S_{p_m}. Notice, however, that the literature on transparency is, ambiguous on whether more accurate public information is advantageous. An often cited result by Morris & Shin (2002) is that more accurate public information can make agents overreact to public information, making the economy more sensitive to any forecast errors in the public information. Svensson (2006) shows, however, that with realistic parameters in the Morris-Shin model, more accurate information is welfare improving. Since we do not attempt to model the welfare implications, the normative implications of our results depend on whether one considers information accuracy to be welfare improving or welfare decreasing, which again depends on the assumptions about private information and behavior. Although it is possible to construct models where more accurate public information is welfare reducing, we think that it practice, most central bankers think that the stories they present should have the highest possible informational value for the public.

We assume that the individual judgments (estimates) on each premise-variable are the outcome of draws from some distribution (to be specified). Since the distribution for the median does not have an analytical expression

[6] Trichet (2005) says that "... it is the *duty* of independent central banks to be transparent and to communicate."

Table 3: Relative $RMSE$ of a premise-variable in a story under a conclusion-based (CB) and a premise.based procedure (PB) and a linear decision rule

	$n = 3$		$n = 5$		$n = 7$		$n = 11$		$n = 101$	
	CB	PB	CB	PB	CB	PB	CB	PB	CB	PB
$k = 2$	0.84	0.67	0.80	0.54	0.77	0.46	0.75	0.37	0.71	0.12
$k = 5$	0.95	0.67	0.93	0.54	0.92	0.46	0.90	0.37	0.90	0.12
$k = 10$	0.98	0.67	0.97	0.54	0.96	0.46	0.96	0.37	0.96	0.12
$k = 100$	1.00	0.67	1.00	0.54	1.00	0.46	1.00	0.37	1.00	0.12

for small samples, we base our results on Monte Carlo simulations, where we use 10 000 draws of individual judgments. We will define informational value by the *root mean squared error (RMSE)* of a premise-variable relative to the $RMSE$ of the individual judgments;

$$relRMSE = E\sqrt{(p_{mpc} - p_{true})^2}/E\sqrt{(p_j - p_{true})^2}.$$

The motivation for dividing by the $RMSE$ of the individual judgments is to make the results independent of the degree of noise in the indvidual judgments. If the premise-variable in the story communicated by the MPC is just as (in-)accurate as the individual judgments on the premise-variable, then $relRMSE = 1$.

3.1 Linear decision rules

Consider first the linear decision rule

$$i = p_1 + p_2 + ... + p_k. \tag{5}$$

We assume that the individual judgments (estimates) on each premise-variable are normally distributed. More specifically, we assume that $p_{h,j} \sim N(\bar{p}, \sigma_h^2)$ for all $j = 1, 2, ..., n$ and all $h = 1, 2, ..., k$. We will treat premise-variables symmetrically. It therefore suffices to report the $relRMSE$ for one of the premise-variables to evaluate the informational value of the story. Notice also that with a linear decision rule, a premise- and a conclusion-based decision procedure are normatively equal if we only look at the precision in the interest rate decision, c.f. Claussen & Røisland (2007a). The results of the simulations are summarised in Table 3.

We see that the *relRMSE* is considerably smaller when voting on each premise-variable than when letting the winner choose story, i.e., $relRMSE(p_m) < relRMSE(p_{i_m})$. Generally, we have that the *relRMSE* decreases in the number of MPC members. This is what we will call the "committee gain", which follows from the law of large numbers, or the "Condorcet jury theorem". The committee gain has been launched as an explanation for why we have monetary policy committees (see, e.g., Gerlach-Kristen (2006)). When the individual judgment errors are unbiased and not perfectly correlated, $relRMSE(p_m) \longrightarrow 0$ as $n \longrightarrow \infty$ when the MPC votes on each premise-variable. However, if the MPC's story is the story chosen by the median voter on the interest rate, the gain from increasing the number of members becomes smaller, and it does not converge to zero. Actually, in our simulations the $relRMSE(p_{i_m})$ never gets below 0.70 irrespective of how much one increases n. We also see that $relRMSE(p_{i_m})$ increases in the number of premise-variables. Thus, the accuracy of $S_{\dot{i}_m}$ decreases when the story becomes more complex. This is in contrast to the case where the MPC votes on the premise-variables, where the accuracy of the story is independent of the number of premise-variables.

To summarise the results, we find that a story that is consistent with a conclusion-based procedure is on average further away from the truth than a story consistent with a premise-based procedure. If the accuracy of the communicated story has positive welfare effects, voting on the interest rate and communicating a consistent story has welfare costs. Remember, however, that even if $relRMSE(p_m) < relRMSE(p_{i_m})$, the interest rate itself has the same *relRMSE* under a conclusion-based procedure as under a premise-based procedure. As long as the decision-rule is linear, the interest rate decision under conclusion-based majority voting is on average equally close to the optimal (i.e., full information) interest rate as is the interest rate following a premised-based procedure. The problem with a conclusion-based procedure in this model is therefore not the interest rate decision itself, but the quality of the story consistent with the decision.

3.2 A non-monotonic decision rule

In the previous sub-section, we found that voting on each premise-variable gives more accurate stories when there are more than one premise-variable. However, we have from Proposition 2 that a conclusion-based and a premise-based procedure may also give different stories if there is only one premise-variable, and this enters non-monotonically in the decision rule. This might be seen as a special case, but policymakers may in fact often face this situation, as we shall see in the following application.

Suppose that the MPC's objectives can be represented by a the following loss function:

$$L_t = E_t(1-\beta)\sum_{l=0}^{\infty}\beta^l[\pi_{t+l}^2 + \lambda y_{t+l}^2] \tag{6}$$

where β is the discount factor. Let the economy be represented by a (somewhat simplified) New-Keynesian model:

$$\pi_t = \beta E_t \pi_{t+1} + \kappa y_t + u_t \tag{7}$$

$$y_t = E_t y_{t+1} - (i_t - E_t \pi_{t+1}), \tag{8}$$

where equation (7) is the New-Keynesian Phillips curve, where u_t is a "cost-push" shock, for example, stemming from stochastic variations in firms' market power. Equation (8) is a dynamic IS-curve, which can be derived from the Euler equation for an optimal consumption path. We assume for simplicity a unit coefficient on the interest rate, and disregard stocastic fluctuations in the neutral real interest rate (or "demand shocks").

The first-order condition for optimal time-consistent policy is[7]

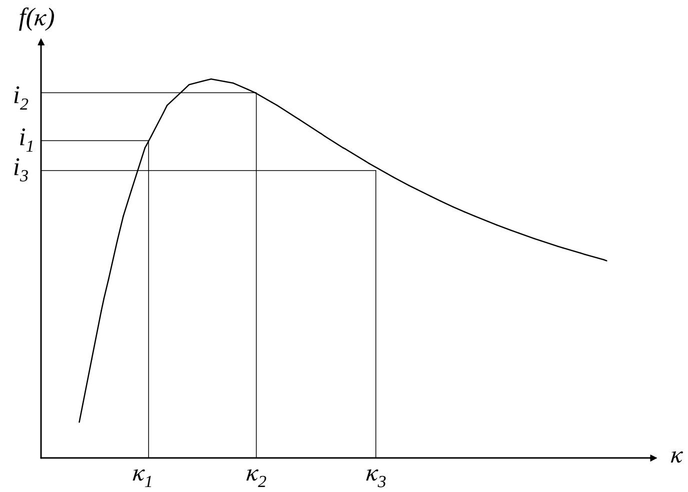
$$\kappa \pi_t + \lambda y = 0. \tag{9}$$

In rational expectations equilibrium, where $E_t \pi_{t+1} = E_t y_{t+1} = 0$ under a discretionary policy and no auto-correlation, the optimal interest rate is given by

$$i_t = \frac{\kappa}{\kappa^2 + \lambda} u_t. \tag{10}$$

Assume that the MPC members agree on the size of u_t and λ, but disagree on the size of κ. The only premise-variable in the decision rule is then κ. The decision rule is illustrated in figure 1, where we see that $f(\kappa)$ is non-monotonic.

Figure 1: The discursive dilemma under disagreement about κ.



[7] Under commitment to the timeless perspective, the level of the output gap is replaced by the change in the output gap, see Clarida et al. (1999).

Suppose that $n = 3$, and the members have the judgments on κ as in the figure. If the winner of the interest rate vote decides the story, the story becomes $S = \kappa_1$, while if the MPC votes on κ, the story becomes $S = \kappa_2$.

To investigate which story that is closest to the truth, we perform similar Monte Carlo simulations as above. However, instead of using the normal distribution on the individual judgments, we use the $beta(1,1)$-distribution. The motivation for this is that we want to aviod negative estimates on κ, since it is reasonable to assume that although the members disagree about the *size* of κ, they agree about its *sign*, i.e., that a higher output gap gives rise to higher and not lower inflation.

Table 4 shows the simulation results for the case with $\lambda = 0.5$. As in the

Table 4: Relative $RMSE$ of a premise-variable in a story under a conclusion-based (CB) and a premise.based procedure (PB) and a non-monotonic decision rule

	$n = 3$	$n = 5$	$n = 7$	$n = 9$	$n = 11$	$n = 1001$
CB	0.94	0.92	0.91	0.91	0.91	0.97
PB	0.78	0.66	0.57	0.52	0.48	0.05

previous simulations, we see that voting on κ gives a far more accurate story than letting the median voter on the interest rate decide the story. While the former takes advantage of the "committee gain", such that the noise in the MPC's story disappears as n becomes large, this is not the case with the latter approach. The qualitative results are independent on the choice of λ, but the magnitude of the difference between the two approaches depends on λ.Figure 2 shows the *relRMSE* for the two approaches as a function of λ in the case where $n = 5$. The two approaches are equal if λ is close to zero or close to one or above. The reason is that in these cases, all of the judgments fall on the monotonic part of $f(\kappa)$, such that there will be no discursive dilemma. An interesting observation is that $relRMSE(p_{i_m}) > 1$ for some values of λ. This means that letting the winner of the interest rate vote decide the story gives a worse story than letting a completely random member choose it (in which $relRMSE = 1$). The intuition for this can be seen from figure 1 above. If the true value of κ is in an area near the maximum of $f(\kappa)$, members who have estimates on κ close to the true value will very rarely be the median voter on the interest rate. Members that have very low of very high estimates of κ will often become the median voter on the interest rate, which gives a bias towards more noisy stories.

In the model above, we have implicitly assumed that the MPC members are certain about their own estimates, such that they do not take parameter uncertainty into account. If they did so, there would not be certainty equivalence, and there would be an additional term σ_κ^2 in the denumerator

Figure 2: relRMSE under a conclusion-based (CB) and a premise-based (PB) procedure as a function of "lambda".

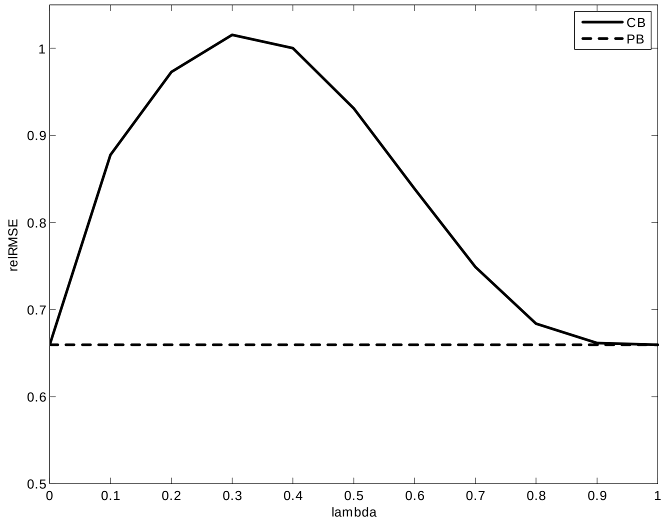


Figure 3:

in equation (10), which is the variance of the judgment errors.[8] However, this would not change the results as regards the quality of the story, since we can take this into account simply by substituting λ equation (10) with $\tilde{\lambda} = \lambda + \sigma_{\kappa}^2$. Taking Brainard uncertainty into account would only make these results more general, as this would also make the decision rule following from disagreement about the coefficient on the interest rate non-monotonic, as shown in Claussen & Røisland (2007a).

To summarise, we find that a premise-based procedure gives a story which tends to be considerably closer to the true but unobservable story than does a conclusion-based procedure. Claussen & Røisland (2007a) found that unless the MPC members were overconfident, a premise-based procedure tends to give better interest rate desicision. Here, we have shown an other argument in favour of premise-based decisionmaking that is robust to the degree of overconfidence, and which also applies to linear decision rules.

4 Institutional design

The results in section 3 show that if a story should be both consistent with the decision and be as close as possible to the true (but unobservable) story, the MPC should vote on each premise-variable, and the interest rate decision

[8] See Claussen & Røisland (2007a).

should follow from the story representing the majority view on each premise-variable. This result has institutional implications, since it gives a case for designing institutions that support premise-based decisionmaking. It can be argued that monetary policy decisions are, to some extent, premise-based, as MPCs spend considerable time on discussing premises like the state of the economy and the inflation outlook. However, they vote directly on the interest rate, and it is not reasonable to assume that the individual members feel committed to the aggregate judgment on the premises when voting on the interest rate. This is in particular the case if the MPC members are individually responsible for their interest votes, as are e.g., members of the MPC at the Bank of England.

One potential practical difficulty with implementing a premise-based procedure is discussed by Faust & Henderson (2004): MPC members with different views may have less difficulties of agreeing on and implementing policy directly than agreeing on all the premises for the policy. We find, however, this argument less convincing, since the premise-based procedure does not require that the MPC members *agree* on all the premises. They may agree to disagree, and still reach a collective judgment, for example by majority voting. Another problem is that voting on each premise-variable in the story might be impractical and time-consuming. However, in practice, the discussions in MPCs tend to focus of a limited number of key issues which have the strongest implications for monetary policy. A more important practical problems of premise-based decisionmaking, which we have ignored in the theoretical analysis, is that it is often difficult to specify a many premise-variables sufficiently precise to have a meaningful vote. For example, the MPC's judgment on the degree of financial fragility might have important policy implications, but is difficult to quantify. For many premise-variables that are difficult to quantify, the MPC members might confine themselves to vote on qualitative judgments, such as "the financial system is (not) fragile". How such qualitative judgments would affect the results on premise-based conclusion-based decisionmaking is an issue for future research.

A more fundamental problem of a premise-based decision-making procedure is *strategic voting.* The MPC members can manipulate the result of premise-based decision-making by reporting false judgments on the premise-variables. If every MPC members votes strategically under a premise-based procudure, the outcome would be equal to the outcome of a conclusion-based procedure, and so will the story. In principle, there is no way of preventing policymakers to act strategically. In practice, however, it is reasonable to assume that there is some collective discipline among MPC members that may reduce the scope for strategic voting. Moreover, there exist institutional devices, such as *core models* and *inflation reports,* which might support premise-based decisions. We will discuss these devices in turn.

4.1 Core model

Central banks use models to guide their forecasts and interest rate decisions. Most central banks do not only use one model, but rather a suite of models. The advantage of having a suite of models is obvious. To cite George Box (1979): "All models are wrong, but some are useful". Different models have different strengthes and are useful for different purposes. Although a suite of models approach is advantageous, there is also a danger that each policymaker can "pick a model" to justify his/her judgment on the policy conclusion. Then, the MPC members' preferred interest rates may be based on different models and views on economic mechanisms. In one sense, it is advantageous that policymakers have different views on economic mechanisms, since this may make the monetary policy decisions more robust. However, we have shown that the MPC members should not take their different views on the model the whole way to their interest rate votes, but instead aggregate the views into one "model" representing the MPC's views.

Many central banks have chosen to let one particular model - often called the 'core model' – play a dominant role within the suite of models. The main reason for having a specific core model is probably that it helps coordinating the analysis and forecasting process within the bank. Our results suggest that there is a rationale for having a core model that goes beyond its practical use as a coordination tool: It can be viewed as an institutional device to support a premise-based decision-making procedure. In order to support a premise-based procedure, it is advantageous if the core model is "owned" by the MPC, and not only by the central bank staff. This would make it more difficult for MPC members to propose a story that does not reflect the mechanisms of the core model.

4.2 Inflation reports

Most inflation targeting central banks publish *inflation reports* (or monetary policy reports). These reports have both an external and an internal role. The external role has to do with providing transparency and accountability, and to manage private sector expectations. The internal role is to provide a common analytical framework for analyzing the state of the economy and forecasting economic developments. An important part of inflation reports is a description and analysis of the current state and the process ahead. The inflation reports can be viewed as the central bank's main instrument for communicating a story. If the inflation report is "owned" by the MPC, and the MPC members have different judgments of the current state of the economy, they have to reach an aggregate judgment of the state in order to present a consistent analysis in the inflation report. The description of the state of the economy in MPC-owned inflation reports can thus be interpreted as the MPC's aggregate judgments on a set of important premise-variables for the interest rate decisions.

In addition to identifying and estimating shocks, the inflation report presents forecasts of inflation and other macroeconomic variables. The core macroeconomic model plays a key role in the forecasting process. One could argue that when the MPC has agreed on a certain forecast, it has then also agreed on an implicit model, since the forecasts rest on certain assumptions and specifications of the economic process. From the point of view of premise-based decision-making, it may thus not be necessary to agree on a specific core model in addition to the forecasts in the inflation report. It is, however, possible that MPC members can agree on the forecasts, but disagree on the economic mechanisms, since different models, or different calibrations of the same model, can give the same forecast. The implications for monetary policy might, however, be different even if they give identical forecasts.[9] Therefore, inflation reports do not make a core model fully superfluous as an institutional device for premise-based decisionmaking.

5 Conclusions and issues for future research

We have analysed how an MPC can come up with a consistent story when the committee members believe in different stories. We show that the only alternatives that give unique and consistent stories are: (i) vote on the interest rate and let the winner decide the story, (ii) vote on the elements of the story and let the interest rate follow from the story. The two procedures tend to give different interest rate decisions and different stories, due to an aggregation inconsistency known as the "discursive dilemma" in the social choice literatue.

Since the two alternative procedures tend to give different stories (and interest rate decisions), we have investigated which of the procedures that tends to give the better stories. We find that alternative (ii) gives stories where the estimates of the premise-variables have considerably lower root mean square errors than under alternative (i). Thus, our results give an argument in favour of premise-based, as opposed to conclusion-based, decisionmaking. Institutional devices that may support premise-based decisionmaking are a core model, which reflects the MPC's views on the key economic mechanisms, and an inflation report, "owned" by the MPC, which represents the aggregate judgments on the key variables.

The paper has considered quantitative elements of stories, that is, the case where the MPC members disagree on the correct size of variables and parameters. An issue for future research is how to find consistent stories when the MPC members also disagree on *qualitative* features of the story. For example, the MPC members might believe in different economic theories.

[9] The might, for instance, have different transmission mechansims.

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