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Revealing monetary policy preferences*

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Abstract

This paper uses multiple criteria decision making, also termed conjoint analysis, to reveal the preferences of central bank policy-makers at the Reserve Bank of New Zealand. Guided by the Policy Targets Agreement between the Governor of the Reserve Bank and the Minister of Finance, we identify policy-makers' willingness to trade off inflation outcomes for reductions in volatility in GDP, the exchange rate, and interest rates. Using 1000Minds software, policy-makers are presented with a sequence of pairwise choices that ultimately quantify which macroeconomic attributes are most important to them. The paper also distinguishes between the preferences of senior management, and a broader cross-section of economists and other staff.

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1 Introduction

Preferences underlie all decisions and are therefore at the heart of all economic analysis. In this paper we directly investigate the preferences of central bankers with respect to macroeconomic outcomes. If, as is commonly believed, the actions of central banks have a material impact on the macro economy, it is important to understand what preferences underpin monetary policy decisions.

In inflation-targeting regimes central banks are typically granted a large degree of independence or autonomy to determine monetary policy actions. In some cases inflation-targeting central banks have been granted both goal and instrument independence. Under goal independence, central banks specify their objectives as well as the means by which they pursue those objectives, whereas under instrument independence the government specifies the central bank's objective but delegates the achievement of the objective (and the choice of means) to the central bank. However, even under regimes that only confer instrument independence, it is clear that delegation leaves monetary policy-makers with a wide degree of latitude and so their own preferences may have a material impact on their actions. Consequently, it is natural to investigate the properties of the policy-makers' preferences, to understand what outcomes they prefer.

The Reserve Bank of New Zealand's framework, while unique in a number of dimensions, is fairly typical of instrument independence. Reflecting concerns about politically-induced business cycles, the Reserve Bank of New Zealand Act (1989) makes the Governor of the Reserve Bank the sole independent decision-maker, explicitly making the governor responsible for the monetary policy actions of the Reserve Bank. The Act identifies *price stability* as the Bank's pre-eminent goal (section 8), without being specific about what price stability means in practice. The Act also requires the Minister of Finance to fix, in agreement with the Governor, policy targets for which the Governor is responsible (section 9). Since 1990 there have been nine Policy Targets Agreements (PTAs), though a number have been substantively similar to earlier versions. The inflation target has, however, drifted up over time, from $0-2$ percent initially, to $0-3$ percent in 1996, and $1-3$ percent from 2002.

The 2008 version of the PTA (following on from the 2002 and 2007 versions) also specifies in clause 4b that "the Bank shall implement monetary policy in a sustainable, consistent and transparent manner and shall seek to avoid unnecessary instability in output, interest rates and the exchange rate." Thus, not only is the primary function of the Bank to maintain price stability, but it must also be mindful of instability in other macroeconomic variables. This paper investigates the extent to which these additional considerations materially enter policy-makers' preferences.

Monetary policy-makers, like all decision-makers, do not wear their preferences on their sleeves. Consequently, researchers have to make *inferences* about preferences based on observed information. A prototypical approach to such inference is to infer policy-maker preferences on the basis of the actual interest rate decisions that were undertaken; see for example Dennis (2004) and Dennis (2006). An inherent difficulty with this approach is that interest rate decisions depend on both the policy-makers' preferences and the constraints posed by the economy. Unfortunately these constraints are not directly observable, so suppositions need to be made about the structure of the economy to then be able to back out a characterisation of the policy-makers' preferences. This task is complicated since, as Minford and Srinivasan (2008) show, properties of the constraints can be readily confounded with the properties of the policy-makers' preferences.

A number of papers have sought to characterise the preferences of individual policy-makers by examining their voting pattern, as revealed by the minutes of monetary policy committee (MPC) meetings, where such MPCs are the primary decision-making bodies. This approach has the advantage of attributing preferences to individual agents, rather than treating the institution as a single coherent decision-maker, and thus provides an opportunity to consider whether individual policy-makers have similar preference functions.

Loosely speaking, monetary policy committees often have 'internal' and 'external' members. For example, the voting members of the Federal Open Markets Committee include both governors of the Federal Reserve and presidents of the regional federal reserve banks. Belden (1989) examines whether the preferences of the voting presidents differ from the governors of the Board of Governors by examining the pattern of dissenting votes. (Havrilesky and Gildea 1991 comment on the difficulties of using dissenting votes as unbiased measures of policy preferences.)

Understanding how preferences or performance might be related to observable characteristics is an ongoing preoccupation. Meade and Sheets (2005) examine regional influences on voting patterns, while Adolph (2004) conditions on policy-makers' past employment histories to see what impact policy-maker 'conservatism' has on macroeconomic outcomes.[1]

Riboni and Ruge-Murcia (2008) provides a further example of this kind of research. They infer preference parameters for individual members of the Bank of England's monetary policy committee by estimating policy reaction functions based on individual, published voting patterns. Policy-makers are also assumed to be 'sincere voters', revealing their true preferences. In other words, the members of the MPC do not try to interact strategically with each other, to influence each other's voting behaviour.

Riboni and Ruge-Murcia assume that each member of the MPC simply differs in their preferences for output (or unemployment) stabilisation relative to the stabilisation of inflation. There are only 18 past and present members in the sample considered, as a number did not participate in the MPC for very long, thus providing little data with which to infer the members' preferences. As the Bank of England's committee has both internal members appointed from within the Bank of England and external members appointed by the Chancellor of the Exchequer, a natural focus is on whether members from these two groups have similar preferences.

Researchers who infer preferences from voting patterns must still take a position on the underlying constraints that policy-makers face as they make their policy decisions, or at least on members' beliefs regarding the structure of the economy. For example, in Riboni and Ruge-Murcia (2008) the constraints faced by the policy-makers, ie the macro dynamics of the economy, are assumed to be commonly understood by all members. Riboni and Ruge-Murcia also assume that private sector expectations are invariant to the voting decisions of the members.

In this paper we take a different, completely novel approach to identify policy-makers' preferences. Rather than infer preferences from behaviour we simply ask the policy-makers to make a sequence of pairwise choices involving macroeconomic tradeoffs, in order to evaluate the 'value' attached to the attributes implicit in the possible outcomes. On the basis of these choices, and making some assumptions about the preference function, we can directly derive the values assigned to the attributes. Like the sincere voting assumption of Riboni and Ruge-Murcia (2008), we assume that policy-makers are prepared to reveal their true preferences in these pairwise comparisions.

Formally, this paper employs multiple criteria decision making (MCDM) to reveal policy-makers' preferences. MCDM is a method for assessing which

[1] Adolph's measure of conservatism is based on the career of the median central bank board member.

attributes of an object or choice are most important to a decision-maker. MCDM, sometimes called multi-attribute decision analysis, dates back to at least Raiffa (1969) (republished as Raiffa 2006). Raiffa provides a platform for prescriptive decision analysis, specifying how decisions should be made when there are multiple attributes that the decision-maker cares about.

Much of the analytical machinery, though specialised by certain assumptions, is entirely consistent with standard microeconomic decision-making, as described in Kreps (1990), Varian (1992) or Mas-Colell, Whinston, and Green (1995). A key restriction is that the analysis focuses on *additive* utility functions, but this kind of analysis also has a long history in economics, see for example Krantz et al (1971) and Keeney and Raiffa (1993).

A key aim of the early literature in multi-attribute decision analysis was to derive axioms that could be used to justify the approach, and other more applied work has centred on uncovering the values attached to different attributes, and on helping decision-makers to achieve the outcomes that they do indeed consider to be 'best'. This paper contributes to the applied literature, investigating the values attached different macroeconomic attributes by central bank policy-makers.

Multiple criteria decision making, in its conjoint analysis form, is widely used in marketing to assess which attributes of a product are important, and to assist in product placement. Green and Srinavasan (1978) is a seminal reference on conjoint analysis, while Green and Srinavasan (1990) provide a more recent update. Orme (2005) provides an introduction to conjoint analysis and Green, Krieger, and Wind (2001) provide a nice historical perspective. The conjoint analysis form of MCDM has roots as far back as Luce and Tukey (1964). Conjoint analysis has also become popular in health economics, to identify different attributes of care, and to prioritise factors that may influence access to services (factors that may, for example, influence how high or low one is placed in a queue for an organ transplant or other treatment). Oudhoffa et al (2007), for example, discuss the prioritizations of surgical waiting lists.

Section 2 discusses the microeconomics of preferences, and outlines the set of outcomes over which we try to elicit monetary policy-makers' preferences. The specification of the attributes of interest is guided by the Reserve Bank's Policy Targets Agreement. Section 3 reports the outcomes of the analysis, and section 4 concludes.

2 The choice set and preferences

In this section we lay out some basic groundwork associated with preferences, before tailoring the analysis to the monetary economics context of primary interest.

In conventional microeconomic theory a decision-maker has a (binary) weak preference relation (denoted by $\succsim$ in this paper) that enables the decision-maker to specify whether:

- an option A is weakly preferred to an option B, $A \succsim B$;
- an option B is weakly preferred to option A, $B \succsim A$; or
- whether both statements are true, $A \succsim B$ and $B \succsim A$, which we refer to as indifference and denote $A \sim B$.

As a corollary, an option A is strictly preferred to option B, denoted $A \succ B$, if $A \succsim B$ and not $B \succsim A$.

Suppose these outcomes are defined on a sample space Ω. The weak preference relation is assumed to be *complete* and *transitive*. Completeness means that $A \succsim B$ or $B \succsim A$ or both (any two possibilities can be compared), and transitivity means that $A \succsim B$ and $B \succsim C$ implies $A \succsim C$.

This representation determines what choices the decision-maker would make when presented with a set $X \subset \Omega$ of alternatives. A 'choice' in this context is the set of 'best' elements from X, ie $c(X; \succsim) = \{x \in X : x \succsim y \quad \forall y \in X\}$. The set may be empty depending on the definition of the set X (if, for example, X is not a closed set), but the choice set will be non-empty if X is finite.

It is common for economists to describe this weak preference relation using a utility function, $U : \Omega \to \mathbb{R}$, that has the property:

$$A \succsim B \Longleftrightarrow U(A) \geq U(B) \tag{1}$$

This utility function provides an ordinal ranking of different outcomes, but the scale of the utility function is of no inherent interest (ie the utility function is not cardinal).

2.1 Preference specifics

We are interested in deriving preferences for objects that have multiple attributes. In this paper, we assume that utility is *additive* across the attributes of interest. Alternatively, this assumption could be thought of as a first order approximation to the underlying nonlinear utility function. Each attribute makes a part-wise contribution to the utility of the object and any interactions between the attributes are of second order interest. The assumption of linearity helps to reduce respondent burden when trying to elicit preferences.

Let z be an $n \times 1$ vector that defines a specific object with n attributes (assume that the maximum number of attributes an object may have is n). Define the space of all possible objects as Ω, such that $z \in \Omega$.

The decision-frame for the 1000Minds software used in this paper requires one to specify an ordered categorical scale for each attribute. The i^{th} element of z, which we denote z_i, is an element in the i^{th} dimension of Ω. If there are M_i possible outcomes for attribute i, then the total number of possible outcomes is $\Pi_{i=1}^{n} M_i$. For notational convenience, assume that $M_i = M$ for all i.

If an underlying attribute is continuous, then the attribute needs to be partitioned into discrete, ordered, non-overlapping categories.

For analytical tractability, each attribute's outcome is ordered from worst to best. We denote preferred outcomes with higher subscripts so the respondent specifies $z_{im} \succ z_{im-1}$ for attribute i and $m > 1$. Transitivity implies that $z_{im+1} \succ z_{im} \succ \ldots \succ z_{i1}$. The utility contributions of each attribute are thus monotonically nondecreasing in the index of the attribute.

Define the utility contribution of attribute z_i as u_i. Let $u_{i1}, \ldots, u_{iM}$ denote the possible utility outcomes from the i^{th} attribute. The total utility of the multi-attribute object, given the independence of the part-worth utility terms, is:

$$U(z) = U([z_1, \ldots, z_M]') = \Sigma_i^n u_i \tag{2}$$

Our analytical objective is to determine what part-wise utility values u_{im} to assign to each possible outcome $z_{im}, \quad i = 1, \ldots, n; m = 1, \ldots, M$. These utility contributions are variously called 'scores' or 'points', and the utility functions are referred to as 'additive points systems' or "additive multiple criteria value models with ordered categorical scales."

Given the assumption of additivity in the utility function, we can compute the total value of any object by summing the scores if we know each u_{im}. Consequently, using the utility function and equation (1), we can determine how a decision-maker will choose between any two options A and B.

2.2 Short-cuts in elicitation

In principle it would be possible to elicit preferences by getting decision-makers to rank every outcome against all other possibilities. To do so, however, would be extremely burdensome. By making use of some of the restrictions implicit in the preference function and the specification of the utility function, it is possible to greatly reduce this burden.

Suppose we have a choice problem with four attributes, where each attribute has four possible outcomes. Suppose, for convenience that each of the outcomes is labelled with 1, 2, 3 or 4, and all of the combinations of outcomes are represented by 4-tuples such as $A = [1231]$ and $B = [1224]$, where the first number describes the rank of the outcome in the first attribute, the second number refers to the rank of the second attribute, and so on. As above, assume that higher ranks correspond to more desirable outcomes in each of the attributes.

The linearity in preferences implies that we only need to examine the attributes that are dis-similar to be able to elicit preferences: if two objects have the same outcome for an attribute then each object receives the same part-wise utility from that attribute. For example, in comparing A and B, the part-wise utility contributions from the first and second attributes will be the same. Thus, we only need to consider the part-wise contributions of the third and fourth attributes to determine which option would be preferred, ie compare $[\cdot\cdot 31]$ relative to $[\cdot\cdot 24]$, where $\cdot$ indicates that the attribute is the same across both outcomes.

Another important point is that many options will be *dominated.* For example, if $C = [1211]$ then it is clear from the ordinality of the attributes that option C is dominated by $B = [1224]$ since the first and second attributes are the same for B and C, and the third and fourth attributes of B are both superior to the third and fourth attributes of C.

The elicitation of preferences can also be simplified by noting that a respondent's choice between, for example, [1231] and [1224] also enables us to determine a choice between [1131] and [1124]. In both of these choices, the part-wise utility contributions from the first two attributes cancels out, and the utility from the third and fourth attributes imply the same comparison. By eliminating duplicate or replica comparisons such as these, it is again possible to reduce the respondent burden.

For the 4-tuple with four outcomes in each attribute, there are 4^4 possible outcomes. If a 4-tuple outcome were compared to all possible outcomes (including itself, which would of course be trivial) a person would be faced with $4^4 = 256$ possible pairwise comparisons. However, this burden can be reduced by: i) focusing on pairwise comparisons with only two attributes (assuming the other attributes are the same across the two objects and hence eliminating corollaries); ii) eliminating dominated outcomes (such as the comparison of C and B above); and iii) eliminating reflexive comparisons (which obviously imply indifference).

The 1000Minds software that we use for this analysis is based on a 'paprika' algorithm ('Potentially All Pairwise RanKings of all possible Alternatives').[2] The software automatically reduces the respondent burden by eliminating redundant choices. See Hansen and Ombler (2005) for a description of the algorithm and a discussion of how two objects are assessed to see whether previously expressed preferences determine how they should be ranked. The rest of this section provides an illustrative discussion.

Consider an $n \times M$ matrix $\mathcal{U}$ with an attribute per row, and outcomes of the attributes reported across the columns (for notational convenience we have assumed that each attribute has the same number of possible outcomes). Suppose, therefore, that the part-wise utility from the m^{th} outcome of the i^{th} attribute, u_{im}, is the i, m element of the matrix $\mathcal{U}$.

$$\mathcal{U} = \begin{array}{c} \textbf{Outcomes} \\ \begin{bmatrix} u_{11} & \dots & u_{1m} \\ \vdots & \vdots & \vdots \\ u_{n1} & \dots & u_{nM} \end{bmatrix} \end{array} \textbf{Attributes} \tag{3}$$

The vector $\eta = vec(\mathcal{U}')$ contains the part-wise utilities that we wish to infer. Once these part-wise utilities are known, we can determine how the decision-maker chooses between any possible combination of attributes. (Feasible objects only have a single element from each row of $\mathcal{U}$.)

We face two sets of inequalities that help to tie down the values in $vec(\mathcal{U}')$. First, the monotonicity of the part-wise utility from each attribute means that $u_{i1} \leq u_{i2} \leq \cdots \leq u_{iM}$ for each attribute i.

The second set of inequalities stems from the respondents' choices. Suppose that a person is presented with option $A = [a_1, \dots, a_n]'$ and option $B = [b_1, \dots, b_n]'$. If the respondent asserts that A is weakly preferred to B then that implies that $U(A) \geq U(B)$ or equivalently that $U(A) - U(B) \geq 0$.

The total utility from a particular configuration of attributes can be obtained

[2] Horner and McGinley (2008) provide a survey of decision analysis software, including 1000Minds.

by multiplying a $1 \times mn$ vector with binary elements by the $mn \times 1$ vector $\eta = vec(\mathcal{U}')$. Each binary digit indicates whether a particular attribute-outcome is present in the configuration being considered.

Suppose that there are $M = 3$ outcomes for the $n = 2$ attributes. Then in total there are 3×2 different types of attribute-outcomes. Suppose that $I_A = [0\ 1\ 0\ 0\ 1\ 0]$ is a $1 \times (m \cdot n)$ vector where each element of the vector is either a 1 of a 0. I_A above shows the model A has the second and fifth attribute-outcomes (as represented by ones), whereas all the other attribute-outcomes are turned off (the zeros).[3] Then the total utility from this multi-attribute configuration is:

$$U(A) = I_A \eta \tag{4}$$

Similarly,

$$U(B) = I_B \eta \tag{5}$$

Suppose that $U(A) \leq U(B)$. Then this can be represented as:

$$U(A) - U(B) = (I_A - I_B)\eta \leq 0 \tag{6}$$

The elements in $I_A - I_B$ can be 1, 0, or -1.

The algorithm in 1000Minds seeks to elicit preferences by going through the pairwise comparisons that can be made, typically of objects that only have two attributes explicitly listed; the other attributes are assumed to be the same across both objects.

A preference comparison of two objects thus implies inequalities for the utility of the objects.

Let $F\eta$ denote the matrix of all possible inequalities, so that for example a row of F, denoted F_i, corresponds to $I_A - I_B$. The elements of F can thus be 0, 1 or -1.

The matrix $F\eta$ includes the attribute monotonicity inequalities. Remembering that $\eta = vec(\mathcal{U}')$ we know that the second indexed outcome of the first attribute is preferred to the first indexed outcome of the first attribute. In terms of F, this inequality can be expressed as $[1\ -1\ 0\ 0\ 0\ 0]\eta \leq 0$.

The 1000Minds algorithm starts from the monotonicity requirements and then asks a preference question, which implies a further inequality. We assume that each answer to the question is arranged so that $F_i\eta \leq 0$.

[3] These binary indicators are different to those used in Hansen and Ombler (2005).

Let $F^{(i)}$ define the submatrix that has (i) rows, corresponding to the first $i - q$ preference questions and the q monotonicity constraints.

The paprika algorithm uses knowledge of $F^{(i)}$ to eliminate remaining (not-yet-asked) rows of F from the set of questions to ask the respondent. For example, if $[1\ -1\ 1\ 0\ 0\ 0]\eta < 0$, then we know that multiplying by -1 reverses the inequality sign ie $[-1\ 1\ \ -1\ 0\ 0\ 0]\eta > 0$. Thus, if the decision-maker's preferences are internally consistent, there is no reason to present them with the row that simply reverses the signs of the elements, which simplifies our efforts to elicit the decision-maker's preferences by reducing the number of questions that must be posed.[4]

Suppose that we have two rows such that $F_i\eta \leq 0$ and $F_j\eta \leq 0$. Then we know for two non-negative constants c_i and c_j that:

$$\begin{aligned} c_iF_i\eta + c_jF_j\eta &\leq 0 \\ (c_iF_i + c_jF_j)\eta &\leq 0 \end{aligned} \tag{7}$$

This implies that if we know the inequalities implied by F_i and F_j then we also know that any non-negative combination of them will also satisfy the inequality. Thus, there is no reason to ask the question implied by $F_i + F_j$, for example. In fact, we also know that if c_i and c_j are both negative that $(c_iF_i + c_jF_j)\eta \geq 0$.[5]

Let the sub-matrix $F^{(i)}$, for some arbitrary i, represent a set of vectors that we know about from the i questions that have already been answered and the monotonicity assumptions. We do not need to ask more questions to elicit information about the preferences associated with the matrix $F^{(i)}$. $F^{(i)}$ is nearly, but not quite, a full basis; the preferences defined by $F^{(i)}$ requires the constants c to be either all positive or all negative.

If we are interested in fully characterising preferences, then we must continue asking questions until $F^{(i)}$ fully describes the space defined by: i) F and c's that are all positive; and ii) F and c's that are all negative.

Hansen and Ombler (2005) use linear programming to determine whether an additional row of F, ie F_k or its negative $-F_k$, is determined by $F^{(i)}$ (where $F_k, -F_k \notin F^{(i)}$). If both F_k and $-F_k$ are feasible then existing constraints do not tell us which a respondent would choose. Hansen and Ombler first

[4] The 1000minds algorithm actually allows the respondent to answer a choice question with $A \succ B$, $B \succ A$ or $A \sim B$. The indifference answer $A \sim B$ implies that two inequalities are answered simultaneously, $I_A - I_B \geq 0$ and $I_B - I_A \geq 0$.

[5] Some inequalities can also be ruled out because it is not possible for the attributes to assume two outcomes simultaneously.

examine whether F_k is feasible. If F_k is infeasible, then this implies that $F^{(i)}$ already answer the preference question in favour of $-F_k$. If F_k is feasible, it satisfies the existing constraints and we need to check whether its converse $-F_k$ is also feasible. If $-F_k$ happens to be infeasible then we know the answer to the implied preference question must be F_k, and we do not need to ask the decision-maker this question. If $-F_k$ is also feasible then F_k or its converse should be asked to obtain more information about the decision-maker's preferences.

Once a suitable number of questions has been asked, the part-wise utilities can be determined using linear programming. Multiple solutions will exist (given that utility is not cardinal), but these solutions will all result in the same preference orderings.

The generic linear programming problem is of the following form:[6]

$$\begin{aligned} \max_{(x_1,x_2,\ldots,x_n)} \quad & f_1x_1 + \cdots + f_nx_n \\ s.t. \quad & a_{11}x_1 + \cdots + a_{1n}x_n \leq c_1 \\ & \vdots \\ & a_{n1}x_1 + \cdots + a_{nn}x_n \leq c_n \end{aligned} \tag{8}$$

Given objective coefficients $f_1, \ldots, f_n$ and the coefficients in constraints, ie $a_{11}, \ldots,$ a_{nn} and $c_1, \ldots, c_n$, what values should we choose for $u_{11}, \ldots, u_{nM}$ (the x's in the generic characterisation above)? In our problem, the utilities or points are the objects that we want to choose, the a's are all equal to one, and the c's are equal to zero. The objective function coefficients, the f's, are also equal to zeros. The utility function is not cardinal and hence not unique; one could double all the part-wise values and that would still imply the same preference ordering, eg consider doubling the utilities on the right hand side of equation 1. Thus, we are not interested in a unique vector of part-wise utilities that maximises the utility function, rather we are simply interested in finding a vector of utilities that satisfies a set of constraints.

The ranking implied by the utility function is preserved by affine transformations such as $\tilde{u} = a + bu$ provided that $b > 0$. This means that it is possible to rescale the utility function by subtracting a constant and multiplying by another. By appropriately selecting these constants the utility values can be restricted to the range $[0, 1]$ or (as here) $[0, 100]$. Rescaling the utility in this manner makes it easier to interpret the results and to ascertain the importance attached to different outcomes.

[6] See Mas-Colell, Whinston, and Green (1995) for a brief introduction to linear programming.

The next subsection explains how we use the analytical framework described here to elicit the preferences of monetary policy-makers.

2.3 The PTA and policy-maker preferences

As discussed in the introduction, the Policy Targets Agreement signed by the Minister of Finance and the Governor of the Reserve Bank provides more direction about the objectives assigned to the Reserve Bank than the Reserve Bank Act itself.

The inflation objective specified in clause 2b) of the PTA says "the policy target shall be to keep future CPI inflation outcomes between 1 per cent and 3 per cent on average over the medium term". And in clause 4b) the Reserve Bank is enjoined to "seek to avoid unnecessary instability in output, interest rates and the exchange rate".

The expression 'over the medium term' is a little vague, but the adjective 'future' clearly implies the horizon for the inflation objective is forward-looking. The Reserve Bank's November 2002 *Monetary Policy Statement* (p 4) further clarifies the definition of the medium term, noting:

"In typical circumstances, we will give most of our attention to the outlook for CPI inflation over the next three or so years. If the outlook for inflation over that period is inconsistent with the target range, then monetary policy will be adjusted. Our goal in making that adjustment will be to ensure that, in the absence of significant unforeseen events, inflation will be back within the target range in the latter half of that 3 year period."[7]

The use of 'unnecessary' in clause 4b of the PTA also introduces some ambiguity with respect to the instability terms. Further, no precise definition is provided for 'instability' – it is not obvious whether the Reserve Bank should be concerned about, for example, daily, weekly, or annual volatility, or even volatility over the entire business cycle.

In this paper we assume that clause 4b) is worried about macroeconomic volatility over the whole business cycle. We couch this volatility in this paper in terms of the peak-to-trough variability in the variables, expressed in percent terms. This is broadly in line with the Reserve Bank's foreign exchange (FX) intervention policy, which seeks to intervene when the exchange

[7] http://www.rbnz.govt.nz/monpol/statements/nov02.pdf.

Table 1
Preference domain Ω

Variable	**Partitions**
Inflation deviation from target	
	$> 5\%$
	2 to 5%
	1 to 2%
	0 to 1%
GDP growth cycle (peak to trough)	
	> 4 %
	2 to 4%
	0 to 2%
Exchange rate cycle (peak to trough)	
	$> 30\%$
	15 to 30%
	0 to 15%
Interest rate cycle (peak to trough)	
	$> 10\%$
	5 to 10%
	0 to 5%

rate is 'nearing its cyclical extremes'.[8]

A completely different perspective would pertain if volatility referred to the distribution of, say, interest or exchange rate changes over a month or quarter. There might be quite small volatility (variance) in a single quarter, but over time the trough-to-peak cycle might become quite large.

Table 1 describes the domain over which we seek to elicit preferences.

The inflation outcomes from table 1 are depicted in figure 1, assuming that the target level of inflation is 2 percent. The different inflation options are represented by the line segments with different properties (dotted line, solid line, double line, triple line). The best inflation outcome is for the deviation of inflation from target to be between $0-1$, ie for inflation to remain between 1 and 3 percent given a target of 2 percent. This best inflation category is represented by the dotted line in the figure. For simplicity, we have assumed that positive and negative deviations are treated symmetrically, though of

[8] See http://www.rbnz.govt.nz/speeches/0148372.html for a discussion of the FX intervention policy.

course there is research that investigates this symmetry assumption explicitly, such as Karagedikli and Lees (2007) and Cukierman and Muscatelli (2008).

Figure 1
Inflation-deviation line segments

$$-\infty \Longleftarrow\!\!\dashv -3 \vdash\!\!\!=\!\!\!=\!\!\dashv 0 \vdash\!\!\!-\!\!\!-\!\!\dashv +1 \vdash\cdots\dashv +3 \vdash\!\!\!-\!\!\!-\!\!\dashv +4 \vdash\!\!\!=\!\!\!=\!\!\dashv +7 \vdash\!\!\Longrightarrow +\infty$$

inflation axis

In the analysis presented in this paper, the attribute domain Ω has four attributes:

$$z = [\tilde{\pi}, yVol, iVol, ERvol]' \in \Omega \tag{9}$$

where $\tilde{\pi}$ is the deviation of inflation from target; $yVol$ represents peak-to-trough volatility in year-on-year output growth; $iVol$ is the peak-to-trough volatility in the level of interest rates; and $ERvol$ is peak-to-trough volatility in the level of the exchange rate. For simplicity, we assume that the cycle is symmetric, so that the peak-to-trough cycle is the same size as the trough-to-peak cycle.

It should be noted that the central bank – or the Governor – is assumed to trade off a change in inflation (say higher average inflation rates) for a reduction in the *volatility* of the other macroeconomic variables. The central bank is not trading off inflation volatility for interest or output or exchange rate volatility according to this specification, nor is a level of inflation being traded off for the level of the exchange rate or the level of interest rates.

To reveal their preferences, policy-makers are repeatedly required to choose between pairs of outcomes, where each outcome has two attributes, selected from the complete set of possible outcomes. For example, the policy-maker might be asked to choose between:

$$A = (\tilde{\pi} > 5\%,\ yVol \in [0, 2]\%) \tag{10}$$

and

$$B = (\tilde{\pi} \in [0, 1]\%,\ yVol \in [2, 4]\%) \tag{11}$$

Another choice might be between:

$$C = (\tilde{\pi} \in [2, 5], iVol \in [5, 10]\%) \tag{12}$$

and

$$D = (\tilde{\pi} \in [0, 1]\%, iVol > 10\%) \tag{13}$$

The point of the survey is to ask enough questions to be able to determine what the 'scores' or part-worths are for the various attribute-outcomes.

3 Survey results

3.1 Survey respondents

Everyone on the Reserve Bank of New Zealand's 'MPCCOM' e-mail distribution list (43 people) was invited to complete an online survey. The Monetary Policy Committee (MPC), which is served by the MPCCOM distribution list, is the primary venue for discussing monetary policy, macroeconomic projections, the Reserve Bank's quarterly *Monetary Policy Statements*, monetary research and so forth. The Monetary Policy Committee includes the members of the 'Official Cash Rate Advisory Group' (OCRAG). OCRAG consists of the governors and a select group of senior staff who provide direct advice to the governor about each tactical interest rate decision, as well as the strategic policy path and likely future interest rate settings. The US Federal Open Market Committee and the Bank of England's MPC both have a nearly equal split between 'internal' and 'external' members (identifying the presidents of the regional federal reserve banks as external members). The external representation on the Reserve Bank's Monetary Policy Committee is more limited, with just two external advisers. The Governor of the Reserve Bank is also the sole independent decision maker, so there is no formal voting record that could be used to derive information about individual member preferences. In this paper we have solely focussed on the preferences of the MPC members who are fulltime employees of the Reserve Bank.

The MPCCOM e-mail distribution list contains a mix of staff, some of whom never attend Monetary Policy Committee meetings, while others attend only infrequently. For the most part, the non-attenders self-selected themselves out of the survey. People from the Economics Department were encouraged to respond, including junior staff in the Forecasting team. Thirty-two people took part in the survey, including eight of the nine OCRAG members (excluding the two external advisers who sit on both MPC and OCRAG). Communications staff and people in the Statistics section of the Economics Department chose not to participate. Although the analysis only focused on current members of the monetary policy committee, this is still a much larger sample of policy-makers than in Riboni and Ruge-Murcia (2008), even though they also use voting records for past members.

Although there is no meaningful internal-external member split in the Reserve Bank's MPC, the analysis below does differentiate between the responses from OCRAG and non-OCRAG members.

3.2 Macroeconomic part-worths

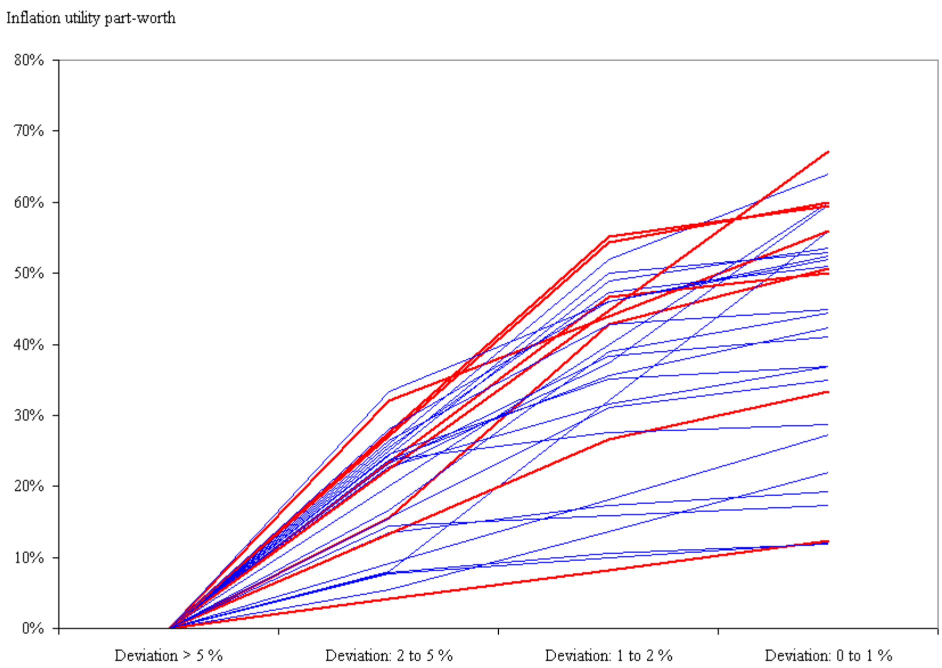
As discussed above, each multi-attribute macroeconomic outcome has a score associated with it, and these multi-attribute scores have been standardized so that they lie in the interval $0-100$ (termed percentages by the 1000Minds software). The best possible multi-attribute object – with the best outcome in each attribute – is scaled to return 100, and the worst multi-attribute outcome has a score of 0. Thus, for example, a multi-attribute object that has an inflation deviation between 0 and 1 percent might instantly score 60 points. If some low volatility (ie good) outcomes are added to this object from other attributes, the total score would rise.

To report the results, we wish to identify the part-worths – the 'part-wise utilities' – for each possible attribute outcome. We can then compare respondents' part-worths, and compare their part-worths to the median and mean values obtained across all respondents.

Figures 2-5 illustrate the part-worths for all the respondents of the survey. Members of the OCR advisory group are highlighted with thick red lines. The scale is such that outcomes to the right (eg low volatility or low deviation outcomes) are preferred to those on the left (large deviations or large volatility). The worst outcomes in each of the attributes – the high volatility outcomes for example – contribute zero utility.

One of the most notable aspects in the figures is the considerable diversity in the utility part-worths, and OCRAG members sometimes have the most extreme part-worths. In figure 2, for example, the bottom thick red line implies that respondent has quite a low value of around 12 points for inflation deviations between 0 and 1 percent, and a value of zero if the inflation deviation is greater than 5 percent. By way of contrast, the top red line has a score of 67 points for inflation deviations between 1 and 2 percent – indicating that the respondent places high value on achieving low inflation deviations – and the same zero value on inflation deviations above 5 percent. The curvature of the lines illustrates that marginal utility is declining in reductions in inflation volatility. If the line segment at the right is fairly flat, an inflation deviation of $1-2$ percent is nearly as good as an inflation deviation of $0-1$ percent. The figures make it apparent that although the utility function is

Figure 2
Inflation deviation part-worth

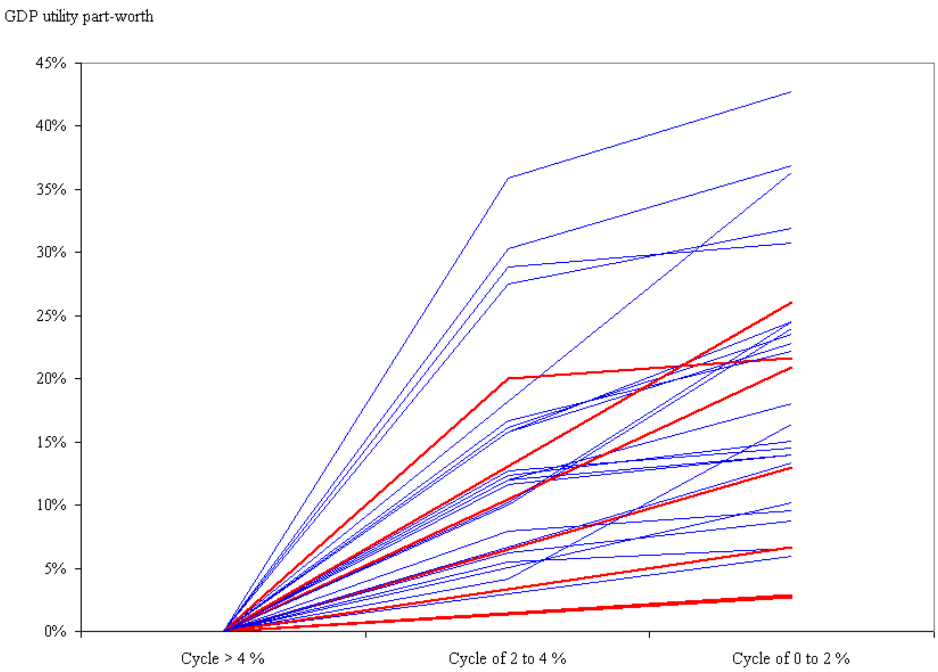


Note: OCRAG members are highlighted with thick red lines

additive across attributes it is still possible for utility to be nonlinear within individual attributes.

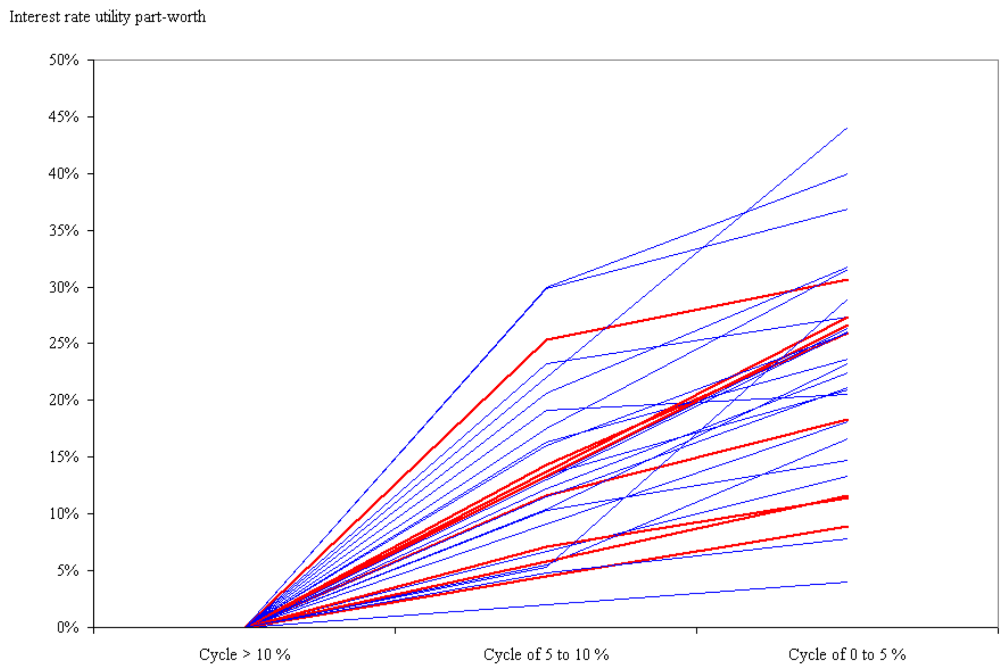
Table 2, in the appendix, summarises the responses from the whole sample. Generally speaking, most respondents placed most weight on low inflation. This is not surprising given the culture implicit in a central bank and the primacy of the inflation target in the Policy Targets Agreement. There were however a number of staff that placed a comparatively low weight on inflation. A few respondents placed a high weight on output stability (with part-worths of 30 or more). Likewise, there were two respondents who placed a great deal of emphasis on exchange rate stability, with part-worths attached to the low exchange rate volatility outcomes of more than 50. However, half of the respondents attached single digit or near-single digit value to the lowest exchange rate volatility, suggesting that they do not regard exchange rate volatility as being particularly important relative to other considerations. Six people placed substantial weight on low interest volatility, with scores of 30 or more on the low interest rate volatility outcome, but on the other

Figure 3
GDP volatility part-worth



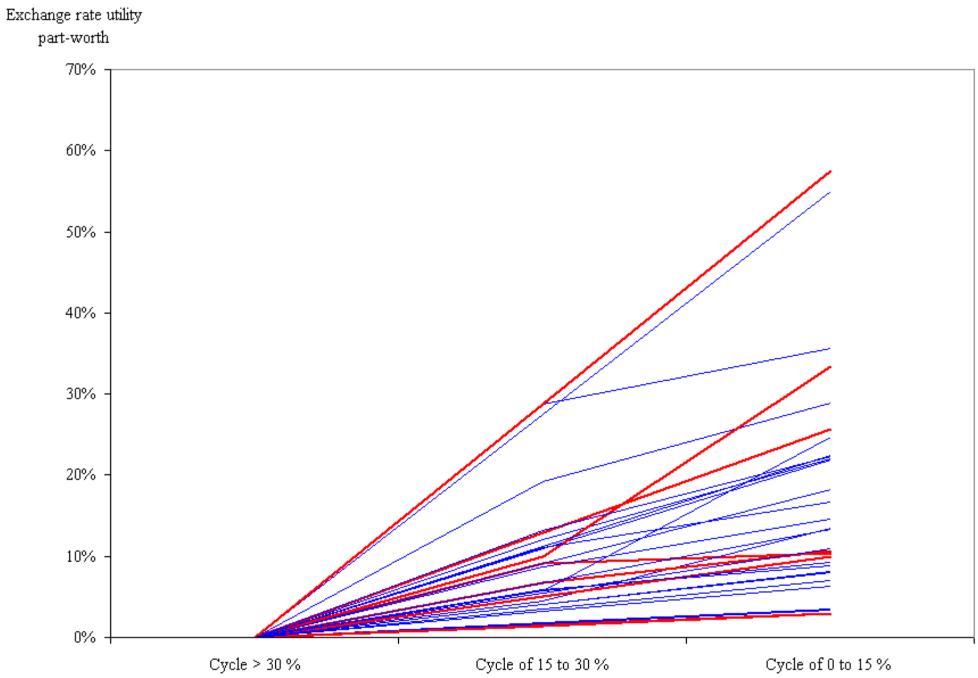
Note: OCRAG members are highlighted with thick red lines

Figure 4
Interest rate volatility part-worth



Note: OCRAG members are highlighted with thick red lines

Figure 5
Exchange rate volatility part-worth



Note: OCRAG members are highlighted with thick red lines

side of the ledger five people placed single digit value to low interest rate volatility. Each of these groups contained an OCRAG member.

Summary statistics are presented in tables 3-4, in the appendix, for the OCRAG/Non-OCRAG split of the sample. The previous figures indicate that there is substantial variation in the part-worths assigned by different respondents and that holds true irrespective of whether one is talking about OCRAG or Non-OCRAG respondents. Given the unusual distributions, it makes most sense to concentrate on the median responses to determine what the 'central' response is. Tables 3 and 4 suggest that on average there is not a great deal of difference in the median responses of OCRAG and Non-OCRAG members.

Figure 6 illustrates, for All Respondents and for the OCRAG/Non-OCRAG sub-samples, the allocation of value across different attributes when we are considering the best possible configuration. Because of the normalisation, these values all sum to 100. The figure illustrates that inflation stability is the major source of value, accounting for around half the value, but low volatilities for interest rates, the exchange rate and GDP are also valued quite highly. The figure suggests the Non-OCRAG sub-sample attaches more value to stability in GDP than the OCRAG group, but attaches approximately the same weight to interest and exchange rate stability.

3.3 Addendum questions: Inflation point targets and type of volatility

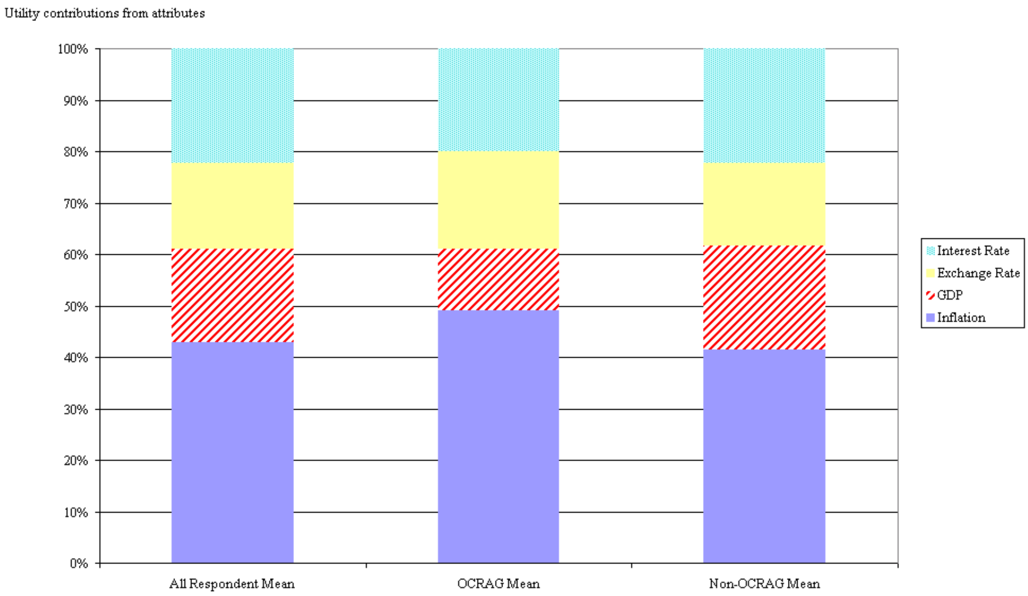
Two additional, rather leading, questions were asked to try to better understand MPC members preferences.

- What should the Reserve Bank's point target level of inflation be? (For example, 2%, the midpoint of the current target band? Or some other number?)
- What kind of macro volatility should we be concerned about? Daily? Weekly? Quarterly? Over the business cycle? Other?

The first question elicited a variety of responses, though these were fairly easy to condense. Most respondents were happy with the mid-point of the band as a point target, though several had to be encouraged to specify point targets rather than ranges.[9] Some people argued for lower point targets, of

[9] Both the Reserve Bank of Australia and the Reserve Bank of New Zealand express their inflation targets as ranges and do not explicitly emphasise a point target.

Figure 6
Allocation of 'value' across the attributes



1, 1.5, and 1.7 percent. However, no one advocated Friedman's position that inflation should be made negative so that the nominal interest rate is zero. Those in favour of lower inflation rates were presumably basing their choices on the view that measurement bias in the CPI is probably no more than 1 percent (this was explicitly the case for at least a couple of the respondents). The respondent who picked 1.7 percent suggested that there was some hope of having inflation outcomes of 2 percent on average if the target was slightly lower. No one advocated point targets higher than 2 percent, though one answer was initially that the midpoint inflation target could be anywhere between 1 and 2.5 percent.

The second addendum question was about the kind of volatility that the Reserve Bank should be concerned about. Given the prompt in the question, most people answered in terms of the frequency that should be considered. There were a variety of answers ranging from quarterly volatility, annual, to volatility over the business cycle, with the latter being most popular overall. Half marks were awarded to two categories if respondents' answers seemed to fall across both. One respondent suggested that the Reserve Bank should be concerned about 'unnecessary' volatility induced by its own actions. Another respondent suggested that preferences should be specified over the levels of variables, rather than volatility per se, just as the level of consumption – not its volatility – enters the prototypical utility function for a consumer. Presumably specifying preferences over volatilities is an effort to characterise the levels of variables across different states of nature. A few respondents suggested that the type of volatility of concern would depend on the variable.

3.4 Contextual remarks

Individual feedback from MPC members provided interesting information about their views on the decision frame and on the rationale for their choices. Two respondents indicated that they had essentially a lexicographic ordering for outcomes with respect to inflation deviations and volatility outcomes. Thus, if inflation featured as an attribute then they always picked the smallest inflation deviation, irrespective of the level of the other attribute.

Several respondents noted that it was hard to understand the decision frame. Part-way through the response process MPC members were provided with illustrations of different peak-to-trough volatilities and an illustration similar to figure 1. One early respondent observed that these figures may have assisted MPC members who had not yet filled out the online survey.

One participant made the following observation after participating in the survey:

"I found many of the choices easier in the survey than in real life because of the options you gave us: I treat any fluctuation in interest rates in excess of 10% as impossible/unrealistic, so would have found 0-3 and 4-7 ranges of interest rates harder to choose between (given the other options). Equally, I will show up unbothered by output volatility because I'd regard 0-2% peak to trough ranges for GDP as pretty unrealistic (though I didn't quite dismiss them as so), and a greater than 4% range not too bothering, given that we've gone through 8 percentage point ranges in the last two cycles. The latter disconcerts me and if I could get 6% ranges I'd probably trade off some other stuff."

One interpretation of this quote might be that it confuses what is *feasible* and what is *preferred*. Feasibility is determined by the constraints of the economy and is supposed to be an independent consideration relative to what is preferred. Another person initially had difficulty answering questions because they could not see how the volatility of exchange rates could be divorced from the volatility of interest rates. Yet again, this is a feasibility consideration rather than a statement about preferences. Alternatively, this might cause one to doubt the 'completeness' of the respondents' preferences – in the formal microeconomic sense.

The person quoted before also observed:

> Reflecting on your question again, I'd also say that it is downside GDP variability (and upside unemployment) that bothers people, and hence prob[ably] should bother us. No one cares, per se, if GDP growth has a couple of 8% years, but they care a lot about a couple of -2% years. [O]f course, that sort of asymmetric concern is precisely what can give rise to inflationary biases.

This issue regarding the decision frame is discussed further below.

3.5 Difficulties in applying the framework to monetary policy

At a fundamental level it is not obvious what the relevant domain should be for central bank preferences. The loss functions ascribed to central banks typically have deviations of inflation from target alongside deviations of the output gap; Svensson (2002) describes this as the consensus view among academics and central bankers of flexible inflation-targeting.

From a welfare perspective of course it is not output per se that should interest people, but their consumption and leisure. Furthermore, with multiple agents there are aggregation problems that are potentially intractable in trying to represent welfare, as implied by Arrow's impossibility theorem for example.

As one of the respondents noted, one of the macroeconomic outcomes that most people care about is unemployment. This view does not really feature in either central bank loss functions in the monetary literature or even in traditional utility analysis, which assumes that work is bad, since it impinges on leisure. Of course, Faia (2007) develops a rationale for monetary policy to respond to labour outcomes because of rigidities in the labour market, but her analysis is a statement about the reaction function, not preferences per se (indeed the monetary authority is solving a Ramsey problem and consumers only care about consumption).

Monetary policy is also an intertemporal decision problem – outcomes in different periods affect central bankers' utility or 'loss'. A central bank, for example, might only care about output deviations from target because it believes such deviations will translate into deleterious inflation outcomes in the future. Conversely, a welfare-oriented central bank might only care about inflation because it has a negative impact on resource allocation, hampering consumption now and perhaps in the future.[10] We have not sought to estimate policy-makers' discount factors, to understand the intertemporal features of preferences, though this is a very interesting avenue to explore.

At an operational level, the ordinality of the preference relation for each attribute also poses some difficulties for the specification of preferences. In this paper the preference domain is assumed to be symmetric around the target level for inflation, so that positive and negative inflation deviations of the same absolute magnitude are treated as being equally undesirable. Unfortunately, this means that we cannot assess the extent to which asymmetries are important. For example, do negative deviations from the inflation target really invoke the same 'losses' as positive deviations?[11] The 1000Minds software also does not by itself elicit the appropriate target level of inflation, though the respondents were asked this question separately.

The choice domain specified in table 1 also precludes tradeoffs in levels for some variables. It is tempting to argue that such tradeoffs are not feasible, for example because the long-run Phillips curve between inflation and output (or unemployment) is vertical. But that mixes the feasible set with preferences, and there is no theoretical reason – given the assumption of completeness – why the policy-makers' preferences could not be elicited over this domain.

Yet another problematic area is choice under uncertainty. This analysis has been conducted assuming known long-run volatilities and inflation deviations. While the general framework is consistent with Von Neumann and Morgenstern's expected utility framework, we have not explored in this paper whether this is a reasonable characterisation of decision-making. Associated with the uncertainty issue is the lack of fully specified probability distributions for the outcome. For example, should the probability be uniformly or (truncated) normally distributed across fixed ranges, and how should one allocate probability for the unbounded ranges?

Lastly, in this paper the choice of domain has been guided by the specification of the policy targets agreement between the Governor and the Minister of

[10] The Reserve Bank of New Zealand's submission to the Finance and Expenditure Committee's 2007-2008 'Inquiry into the Future of the Monetary Policy Framework' states that "[m]onetary policy focuses on maintaining low inflation so as to assist in creating a stable environment that is conducive to economic growth." See `http://www.rbnz.govt.nz/monpol/about`.

[11] See Karagedikli and Lees (2007) and Cukierman and Muscatelli (2008) for a discussion of this issue.

Finance. Given all of the issues raised above, the appropriateness of this domain is open for debate.

4 Conclusion

This paper has discussed the results of an online survey into policy-makers' preferences over macroeconomic outcomes. These preferences were revealed by asking policy-makers to make a sequence of pairwise choices between macro outcomes, where each outcome has two attributes. The sequence of choices posed to respondents depended on previous answers. These questions get directly at the heart of preferences – policy-makers choosing between different outcomes – and do not require a common set of beliefs (or indeed any knowledge of) the constraints imposed by the dynamics of the economy.

The survey indicated that there is substantial variation in policy-makers' preference parameters. The research did show, however, that members of the OCR Advisory Group, the senior managers responsible for directly advising the governor, were similar, on average, to the full sample of respondents.

Lastly, the paper discussed some of the difficulties implicit in this exercise. Specifying the choice domain is particularly problematic and is likely to have a substantial impact on the characterisation of preferences.

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Appendix

Table 2
Part-worths for each attribute-outcome

	All Respondents				
	Mean	Median	Max	Min	Std Dev
Inflation deviation from target					
Deviation > 5 %	0.0 %	0.0 %	0.0 %	0.0 %	0.0 %
Deviation: 2 to 5 %	19.9 %	22.6 %	33.3 %	4.1 %	7.7 %
Deviation: 1 to 2 %	35.4 %	38.6 %	55.1 %	8.2 %	13.3 %
Deviation: 0 to 1 %	43.0 %	47.4 %	67.2 %	11.8 %	16.2 %
GDP growth cycle (peak to trough)					
Cycle > 4 %	0.0 %	0.0 %	0.0 %	0.0 %	0.0 %
Cycle of 2 to 4 %	12.3 %	11.0 %	35.9 %	1.3 %	8.2 %
Cycle of 0 to 2 %	18.2 %	17.2 %	42.7 %	2.7 %	10.0 %
Exchange rate cycle (peak to trough)					
Cycle > 30 %	0.0 %	0.0 %	0.0 %	0.0 %	0.0 %
Cycle of 15 to 30 %	8.9 %	6.3 %	28.8 %	1.4 %	7.7 %
Cycle of 0 to 15 %	16.8 %	12.1 %	57.5 %	2.9 %	13.9 %
Interest rates (peak to trough)					
Cycle > 10 %	0.0 %	0.0 %	0.0 %	0.0 %	0.0 %
Cycle of 5 to 10 %	13.0 %	12.6 %	30.0 %	2.0 %	7.6 %
Cycle of 0 to 5 %	21.9 %	22.9 %	44.1 %	4.0 %	10.1 %

The table reports utility part-worths. These utility values have been scaled so that the worst multi-attribute object has a total value of 0 and the best multi-attribute value has a total of 100. Other objects have values between 0 and 100, reflecting the sum, across attributes, of the individual part-worths.

Table 3
Part-worths for each attribute-outcome

	OCRAG Respondents				
	Mean	Median	Max	Min	Std Dev
Inflation deviation from target					
Deviation > 5 %	0.0 %	0.0 %	0.0 %	0.0 %	0.0 %
Deviation: 2 to 5 %	20.7 %	22.9 %	32.0 %	4.1 %	9.1 %
Deviation: 1 to 2 %	40.3 %	44.4 %	55.1 %	8.2 %	15.6 %
Deviation: 0 to 1 %	48.6 %	53.3 %	67.2 %	12.3 %	17.7 %
GDP growth cycle (peak to trough)					
Cycle > 4 %	0.0 %	0.0 %	0.0 %	0.0 %	0.0 %
Cycle of 2 to 4 %	7.2 %	4.9 %	20.0 %	1.3 %	6.8 %
Cycle of 0 to 2 %	12.1 %	9.8 %	26.1 %	2.7 %	9.7 %
Exchange rate cycle (peak to trough)					
Cycle > 30 %	0.0 %	0.0 %	0.0 %	0.0 %	0.0 %
Cycle of 15 to 30 %	9.4 %	7.9 %	28.8 %	1.4 %	8.8 %
Cycle of 0 to 15 %	19.2 %	10.5 %	57.5 %	2.9 %	18.8 %
Interest rates (peak to trough)					
Cycle > 10 %	0.0 %	0.0 %	0.0 %	0.0 %	0.0 %
Cycle of 5 to 10 %	12.0 %	12.5 %	25.3 %	4.5 %	6.6 %
Cycle of 0 to 5 %	20.1 %	22.2 %	30.7 %	9.0 %	8.6 %

The table reports utility part-worths. These utility values have been scaled so that the worst multi-attribute object has a total value of 0 and the best multi-attribute value has a total of 100. Other objects have values between 0 and 100, reflecting the sum, across attributes, of the individual part-worths.

Table 4
Part-worths for each attribute-outcome

	Non-OCRAG Respondents				
	Mean	Median	Max	Min	Std Dev
Inflation deviation from target					
Deviation > 5 %	0.0 %	0.0 %	0.0 %	0.0 %	0.0 %
Deviation: 2 to 5 %	19.6 %	22.6 %	33.3 %	5.5 %	7.6 %
Deviation: 1 to 2 %	33.8 %	36.5 %	52.0 %	9.9 %	13.2 %
Deviation: 0 to 1 %	41.2 %	43.4 %	67.2 %	11.8 %	16.6 %
GDP growth cycle (peak to trough)					
Cycle > 4 %	0.0 %	0.0 %	0.0 %	0.0 %	0.0 %
Cycle of 2 to 4 %	14.0 %	12.0 %	35.9 %	3.0 %	8.8 %
Cycle of 0 to 2 %	20.3 %	19.4 %	42.7 %	6.0 %	10.0 %
Exchange rate cycle (peak to trough)					
Cycle > 30 %	0.0 %	0.0 %	0.0 %	0.0 %	0.0 %
Cycle of 15 to 30 %	8.7 %	5.8 %	28.8 %	1.5 %	7.4 %
Cycle of 0 to 15 %	16.1 %	13.4 %	54.9 %	3.0 %	12.0 %
Interest rates (peak to trough)					
Cycle > 10 %	0.0 %	0.0 %	0.0 %	0.0 %	0.0 %
Cycle of 5 to 10 %	13.3 %	12.6 %	30.0 %	2.0 %	8.0 %
Cycle of 0 to 5 %	22.4 %	22.9 %	44.1 %	4.0 %	10.5 %

The table reports utility part-worths. These utility values have been scaled so that the worst multi-attribute object has a total value of 0 and the best multi-attribute value has a total of 100. Other objects have values between 0 and 100, reflecting the sum, across attributes, of the individual part-worths.

Table 5
Point target frequency and volatility focus

Point target	**No. of Respondents**
2	22
1.7	1
1.5	2
1	4
Trading partners' average target	1

Type of volatility	**No. of Respondents**
Quarterly	4.5
Annual	7.5
Business cycle	9
Variable dependent	5.5
Other	3.5

Note: Two people who did not fill in the main survey answered these questions; one person who answered the survey did not.