Are World Leaders Loss Averse?*

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Abstract

We focus on the preferences of a very small, but nonetheless extremely salient, group of highly-experienced individuals who are entrusted with making high-stakes decisions that affect the lives of millions of their citizens, heads of government. We test for the presence of a fundamental behavioural bias, loss aversion, in the way heads of government design voting systems for use in international organizations. Loss aversion leads decision makers to design decision rules that inefficiently oversupply blocking power at the expense of the power to initiate affirmative action. We examine the negotiations around the Qualified Majority rule in the Treaty of Lisbon, and find evidence of strong loss aversion ($\lambda = 4.4$).

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1 Introduction

Harking to Kahneman and Tversky (1979), people commonly interpret outcomes as gains and losses relative to a reference point (reference dependence) and are more sensitive to losses than to commensurate gains (loss aversion). Loss aversion can explain an extraordinary variety of otherwise puzzling phenomena: important examples are the equity premium puzzle (Mehra and Prescott, 1985; Benartzi and Thaler, 1995), asymmetric price elasticities (Hardie *et al.*, 1993), downward-sloping labor supply (Dunn, 1996; Camerer *et al.*, 1997; Goette *et al.*, 2004), inefficient renegotiation (Herweg and Schmidt, 2015), contract design (de Meza and Webb, 2007; Dittmann *et al.*, 2010; Herweg *et al.*, 2010), taxpayer filing behavior (Engström *et al.*, 2015; Rees-Jones, 2018), the play of game-show contestants (Post *et al.*, 2008), the putting strategy of Tiger Woods (Pope and Schweitzer, 2011) and the buying strategies of hog farmers (Pennings and Smidts, 2003). Lakshminarayanan *et al.* (2006) experiment with Capuchin monkeys and suggest that loss aversion is a basic evolutionary trait that extends beyond humans. Reflecting this evidence, Rabin (2000, p. 1288) calls loss aversion the "most firmly established feature of risk preferences."

In this paper we focus on the preferences of a very small, highly non-random, but nonetheless extremely salient group of individuals who are entrusted with making decisions that affect the lives of millions of their citizens: heads of government. In particular, we focus on the role of heads of government in international decisionmaking. If indeed loss aversion is basic evolutionary trait then we should expect to observe it within heads of government. On the other hand, as heads of government are surely a highly unrepresentative sample of the human race, it might be supposed that these individuals possess superior, or at least different, faculties of decisionmaking to a more representative sample of the population and, in particular, to the undergraduate students upon which most experimental estimates of loss aversion are based. In particular, if loss aversion goes away with experience and large-stakes, as supposed by some economists (e.g., List, 2003, 2011; Levitt and List, 2008), then world leaders – who make high-stakes decisions on a daily basis – should not be prone to loss aversion.[1] Seemingly consistent with this idea, Inesi (2010) reports experimental findings

[1] For other studies that take a more critical stance see, e.g., Plott and Zeiler (2005), who call into question the general interpretation of gaps between the willingness to pay and the willingness to accept as evidence for loss aversion. Gal and Rucker (2018) question other evidence traditionally interpreted as evidence of loss aversion and argue that loss aversion appears to be best understood as a psychological phenomenon that is dependent on contextual factors, rather than as a stable universal trait.

indicating that powerful people exhibit less loss aversion.[2]

If world leaders exhibit loss aversion this could affect their voting behavior in potentially undesirable ways. In particular, as heightened attention to potential losses might lead a head of government to oppose an action that would, in expectation, be gainful to their citizens. We, however, do not focus on voting behavior, but rather on the role that loss aversion would play when heads of government design the decision rule they then use to determine whether motions are deemed to pass or fail.

To investigate how loss averse, if at all, are world leaders we build on the idea that leaders with differing degrees of loss aversion will design decision rules differently. We distinguish two distinct types of power within international institutions: the power to initiate actions that an actor supports (positive power), and the power to prevent actions that an actor opposes (negative power). From a purely objective, disinterested viewpoint – i.e., in the absence of loss aversion – the positive and negative notions of power seem of equal import. In the presence of loss aversion, however, heads of government are induced to care more strongly about preventing bad outcomes (negative power) than about initiating positive outcomes (positive power). Accordingly, when called to design voting systems for international organizations, loss averse heads of government will choose decision rules in which the hurdle to pass a motion is higher than to defeat it. Such decision rules are biased towards maintenance of the status quo. Following studies that have observed a preference for the status quo in, e.g., consumer and investment behavior (Samuelson and Zeckhauser, 1988; Knetsch and Sinden, 1984; Hartman *et al.*, 1991) we term this asymmetry in favor of the status quo *status quo bias*.

We model the formation of decision rules as the outcome of a Nash bargain between world leaders, and show that the ratio of positive power to negative power is a sufficient statistic for measuring loss aversion. Proceeding in the revealed preference tradition, we seek to infer the coefficient of loss aversion of world leaders by analyzing the adoption of a new Qualified Majority (QM) voting rule for the European Union (EU) Council of Ministers (CoM) in 2007. Precisely, we look for the level of loss aversion that leads to a coincidence between the ratio of positive power to negative power implied in the observed rule adopted by EU heads of government and the corresponding ratio at the Nash bargaining solution.

[2] According to a small literature in psychology, power is also associated with overconfidence (Fast *et al.*, 2012), and the related tendency to discount advice (Tost *et al.*, 2012; See *et al.*, 2011).

The QM decision rule adopted by EU heads of government in 2007 requires that a supermajority of 55 percent of member states must vote in favor of a motion, and the countries in favor must also represent at least 65 percent of EU citizens. Alternatively, a motion also passes if three or fewer countries vote against it. To rationalize as a bargaining outcome the ratio of positive power to negative power implied by this choice of decision rule requires a coefficient of loss aversion of $\lambda = 4.4$. This implies that losses loom approximately four and a half times as large as gains: world leaders are loss averse. Consistent with our finding, Axel Moberg, a witness to the negotiations as a member of the Swedish delegation, documents how member states were largely preoccupied with a negative concept of power, i.e., "...the ability of groups of like-minded states to block decisions" (Moberg, 2002: 261).[3] Quite aside from the effects of loss aversion on voting behavior, many millions of citizens are potentially afflicted by loss aversion embedded in the design of decision rules. In particular, the status quo bias that is induced by loss aversion generates policy persistence – whereby policies remain long after their purpose has been served – and harmful reform deadlocks (e.g., Alesina and Drazen, 1991; Coate and Morris, 1999; Heinemann, 2004).[4]

As well as providing a new exploration of the role of behavioral economics in the nexus of economics and politics (see, e.g., Levy, 2003), our paper contributes to a literature that considers the expected utility derived from voting decision rules (e.g., Laruelle and Valenciano, 2010; Beisbart and Bovens, 2007; Barberà and Jackson, 2006; Beisbart *et al.*, 2005). Our analysis also connects to the wider formal analysis of the QM rule of the CoM (e.g., Felsenthal and Machover, 1997, 2001, 2004, 2009).[5]

The plan of the paper is as follows: Section 2 develops a theoretical framework for understanding positive and negative power under a given decision rule, and constructs a bargaining model for understanding the process by which such decision rules are negotiated. Section . 3 4 5 Proofs are located in Appendix 1, and the Figures appear at the very rear.

[3] A further inside account of these negotiations that buttresses this point is Galloway (2001, Ch. 4).

[4] The United Nations Security Council (UNSC), for instance, is no stranger to deadlock. It employs a decision rule in which nine of its 15 members must vote in favor of a motion, including all five of the so-called Permanent Members – China, France, Russia, the United Kingdom, and the United States. In many recent conflicts, one or more of the Permanent Members has threatened to exercise its veto, leaving the UNSC unable to take action. For more detailed treatments of issues relating to the UNSC see Gould and Rablen (2016, 2017).

[5] Further notable examples in this vein include Le Breton *et al.* (2012), Beisbart *et al.* (2005), Leech (2002), König and Bräuninger (1997), Bindseil and Hantke (1997), Widgrén (1994), and Hosli (1993).

2 Model

In this section we model the adoption of a decision rule by an international voting body as the outcome of a grand bargain between member states. We consider a voting body $\mathcal{N}$ comprised of $N > 1$ member states, to which motions are submitted. The set of voting possibilities is $\{for, against\}$ and the outcome space is $\{pass, fail\}$.[6] For a given motion, F denotes the set (coalition) of members voting for.

For simplicity, we assume that no country is indifferent between acceptance and rejection on any issue, and voting is not costly. In these conditions, countries will vote for or *against* a motion according to whether the motion is gainful or harmful to them, relative to the maintenance of the status quo. Before the motion to be voted on is known, each country belongs to one of two possible types: a for-country, which stands to gain a monetized amount $W^F > 0$ if the motion passes, or an *against*-country j, which stands to lose a monetized amount $W^A > 0$ if the motion passes. Accordingly, a for-country, i, will vote for, hence $i \in F$, whereas, for an *against*-country j, $j \notin F$. If the motion fails, then the status quo position is maintained, so no country gains or loses any amount. We assume that each country is of for-type with probability $p \in (0, 1)$, independently of the others, but countries only learn their type once the motion is known.

2.1 Decision Rules

Formally, a decision rule is a mapping, w, from the set of voting possibilities (as summarized by the set F of countries voting for) to the set of voting outcomes that satisfies the following axioms:

Axiom 1 $w(\emptyset) = fail$.

Axiom 2 $w(\mathcal{N}) = pass$.

Axiom 3 *If* $w(F) = pass$ *then* $w(T) = pass$ *for any* T *satisfying* $F \subseteq T \subseteq \mathcal{N}$.

Axiom 4 *If* $w(F) = pass$ *then* $w(\mathcal{N} \setminus F) = fail$.

[6] We shall apply our model to the EU CoM,in which abstention is a third possible voting outcome. Under the QM decision rule we study in this paper, however, abstention is formally indistinguishable from a vote against. Hence, it can be omitted without any loss of generality.

Axioms 1 and 2 together guarantee the existence of a non-empty coalition of countries that can pass a motion when voting for. Axiom 3 is a monotonicity requirement. Decision rules satisfying Axiom 4 are termed *proper*, and are otherwise termed *improper*. If the rule is improper then multiple (and contradictory) outcomes are possible – making such rules inherently unsuitable to making decisions of substance in international voting bodies.

The QM decision rule of the EU Council of Ministers, as enshrined in the Treaty of Lisbon, Article 9c, is a special case of a class of decision rules we denote by $QM(q_A, q_F, q_P)$. Let the proportion of the total population of countries $i \in \mathcal{N}$ belonging to country i be denoted by $\rho_i \in \mathbb{N}_{>0}$, with $\min\{\rho_i\}_{i\in\mathcal{N}} = \underline{\rho}$: for a motion to $pass$ under $QM(q_A, q_F, q_P)$ it must be either that at least a proportion $q_F \in (0.5, [N-1]/N]$ of members representing a proportion $q_P \in (0.5, 1-\underline{\rho}]$ or more of the total EU population votes for; or that the number of members voting $against$ is less than $q_A \in \{1, \ldots, \lfloor N/2 \rfloor\}$. Formally, let $N_F \equiv |F|$ be the size of F (the coalition voting for), and $P_F \equiv \sum_{i\in F} \rho_i$ denote the population share of the members of F. Then a motion will pass under $QM(q_A, q_F, q_P)$ if

$$(N_F \geq q_F \cap P_F \geq q_P) \cup (N - N_F < q_A).$$

The special case of $QM(q_A, q_F, q_P)$ chosen by EU leaders in the Treaty of Lisbon corresponds to the rule $QM(4, 0.55, 0.65)$. The set of winning coalitions under this rule is depicted graphically as the blue-shaded space in Figure 1. As is apparent in the Figure, a motion may pass under the Lisbon QM rule without the population threshold having been satisfied if the size of the coalition voting $against$ is less than four.

Figure 1 – see p. 27

It is straightforward to observe that (i) $QM(q_A, q_F, q_P)$ satisfies Axioms 1-4 and (ii) that $QM(q_A, q_F, q_P)$ is distinct from the unanimity rule, under which, for a motion to $pass$, all countries must vote for. In the case of $QM(4, 0.55, 0.65)$ it is apparent from Figure 1 that each of the three thresholds $\{q_A, q_F, q_P\}$ actively shape the set of winning coalitions. More generally, however, one or more of the thresholds may become redundant. For instance, if $N - q_A \geq q_F$, then the threshold for members voting for, q_F, plays no role.

2.2 Power: Positive and Negative

We now construct formal measures of power – both positive and negative – in a voting body, extending earlier work in Coleman (1971). Positive power is the extent to which a country i can initiate action. Hence, it is intimately related to the probability, conditional on i having voted for, that a motion will $pass$, $\Pr(pass|i \in F)$. Negative power – the power to prevent action – is similarly related to the probability, conditional on i having voted $against$, that a motion will $fail$, $\Pr(fail|i \notin F)$. A difficulty with using these probabilities as direct measures of power, however, is that they mix power with luck. In particular, if the unconditional probability of a motion passing is denoted by $\Pr(pass) \equiv \omega$, then it is only the differential $\Pr(pass|i \in F) - \omega$ that genuinely reflects positive power separate from luck. Similarly, pure negative power is reflected in the differential $\Pr(fail|i \notin F) - [1-\omega]$. Rescaling these differentials linearly to obtain measures on the unit interval, we arrive at a pure measure of positive power (β_i^+) and of negative power (β_i^-):

$$\beta_i^+ = \frac{\Pr(pass|i \in F) - \omega}{1-\omega}; \qquad \beta_i^- = \frac{\Pr(fail|i \notin F) - [1-\omega]}{\omega}. \tag{1}$$

Under the twin assumptions that (i) all countries vote independently; and (ii) that each country votes for and $against$ with equal probability, β_i^+ corresponds to Coleman's (1971) "power to initiate action", β_i^- to Coleman's "power to prevent action", and ω, corresponds to Coleman's "power of a collectivity to act" (often referred to as simply the "power to act"). We generalize the setting of Coleman (1971), however, for although we retain assumption (i) above, we relax the latter by allowing the probability of voting for to differ from that of voting $against$.[7,8] Our measures of positive and negative power are also closely related to the concept of criticality: country i is *critical* ($i \in C$) when it is able to change the outcome of a vote by switching its vote. The probability that a country is critical in a given vote, $\Pr(i \in C)$, is equivalently represented as ω-weighted average of β_i^+ and β_i^-,

$$\Pr(i \in C) = \omega\beta_i^- + [1-\omega]\,\beta_i^+, \tag{2}$$

or as the p-weighted harmonic mean of $\beta_i^+$and β_i^-:

[7] Although we know of no previous study to relax Coleman's measures in this way, the related absolute Banzhaf index (Banzhaf, 1968) has been relaxed similarly. Our generalization of Coleman's measures corresponds to a special case of the way in which the absolute Banzhaf index is generalized in the "empirical Banzhaf indices" of Heard and Swartz (1998) and the "behavioral power index" of Kaniovski and Leech (2009).

[8] Hence, in the computation of $\{\beta_i^-, \beta_i^+, \omega\}$, the winning coalitions cannot simply be counted, rather each must be weighed in the sum according to its probability of occurrence.

$$\Pr(i \in C) = \left\{ \left[p/\beta_i^- \right] + \left[1 - p \right] / \beta_i^+ \right\}^{-1}.$$

The formal measures of positive and negative power permit an understanding of the constraints facing world leaders in the choice of QM rule. Strengthening any one of the thresholds $\{q_A, q_F, q_P\}$ harms positive power by reducing the probability $\Pr(pass|i \in F)$, but boosts negative power by increasing the probability $\Pr(fail|i \notin F)$. As, however, strengthening a threshold also affects the power to act, ω, the overall effect of a threshold change on $\{\beta_i^-, \beta_i^+\}$ is complex, and potentially non-monotonic. Importantly, however, heterogeneity in country populations drives heterogeneity in the responses of the individual $\{\beta_i^-, \beta_i^+\}$ to changes in the voting thresholds. This implies that, when countries differ in population, they will have different preferences regarding the setting of these thresholds. Accordingly, we shall represent the collective choice of $\{q_A, q_F, q_P\}$ by EU leaders as the outcome of an underlying bargaining process.

2.3 Utility

Following prospect theory (Kahneman and Tversky, 1979; Tversky and Kahneman, 1992) we suppose that countries form preferences over monetized gains and losses relative to the status quo. In particular, we write utility as

$$U(W) = V(W); \qquad U(-W) = -\lambda V(W); \tag{3}$$

where $V : \mathbb{R}_{\geq 0} \mapsto \mathbb{R}_{\geq 0}$ is everywhere increasing and possesses the "set point" property that the status quo corresponds to the point of affective neutrality, so $V(0) = U(0) = 0$. Kahneman and Tversky (1979) propose that preferences display loss aversion when $-U(-W) > U(W)$ for all $W > 0$.[9] In our framework this condition is equivalent to the restriction $\lambda > 1$. Hence, λ is interpreted as a coefficient of loss aversion. A mass of research into the coefficient of loss aversion is summarized in Booij *et al.* (2010: Table 1) and Abdellaoui *et al.* (2007: Table 1), with estimates belonging to the range $\lambda \in [1.07, 4.8]$ and centering around $\lambda = 2$.

[9] This definition of loss aversion is the original one of Kahneman and Tversky (1979), and may be interpreted as applying to "large stakes". A related definition of loss aversion for "small stakes" is given by Köbberling and Wakker (2005), according to which $U(\cdot)$ displays loss aversion if and only if $\lim_{W \uparrow 0} \partial U(W)/\partial W > \lim_{W \downarrow 0} \partial U(W)/\partial W$. As designing voting rules for international organizations is inherently a large stakes context, we do not dwell on the small stakes case. We note, however, that these two definitions of loss aversion are complementary, and both are commonly assumed together in axiomatic models (see, e.g., Bowman *et al.*, 1999; Kőszegi and Rabin, 2007). For other related discussions of concepts of loss aversion see Wakker and Tversky (1993), Schmidt and Zank (2005) and Zank (2010).

Accordingly, the estimate $\lambda = 2.25$ of Tversky and Kahneman (1992) is commonly employed in applications of prospect theory.

With utility defined, the expected utility of country i, before the motion is known, may now be written as

$$\mathbb{E}(U_i) = \Pr(i \in F \cap pass)\, U\left(W^F\right) + \Pr(i \notin F \cap pass)\, U\left(-W^A\right) + \Pr(fail)\, U(0). \quad (4)$$

To properly understand the role of positive and negative power in generating expected utility (4) must be rewritten in a more informative manner:

Proposition 1 *The expected utility of country i, before the motion is known, is given by*

$$\mathbb{E}(U_i) = p\left\{\omega + [1-\omega]\,\beta_i^+\right\} V\left(W^F\right) - \lambda\,[1-p]\,\omega\left[1-\beta_i^-\right] V\left(W^A\right).$$

Proposition 1 relates the expected utility of country i to its positive power, β_i^+, and its negative power β_i^- in an intuitive way. Possession of positive power increases expected utility by increasing the probability that the gain utility $U\left(W^F\right) = V\left(W^F\right)$ is achieved. Negative power also increases expected utility, but by reducing the probability that the loss utility $-\lambda V\left(W^A\right) < 0$ is incurred. To see how loss aversion interacts with positive and negative power note that marginal utility with respect to each form of power are given by

$$\frac{\partial \mathbb{E}(U_i)}{\partial \beta_i^+} = p\,[1-\omega]\, V\left(W^F\right); \qquad \frac{\partial \mathbb{E}(U_i)}{\partial \beta_i^-} = \lambda\,[1-p]\,\omega V\left(W^A\right). \quad (5)$$

We stress in interpreting (5) that heads of government can, in actuality, only choose the thresholds $\{q_A, q_F, q_P\}$; movement of a threshold typically alters β_i^-, β_i^+ and ω simultaneously in an analytically complex way. This caveat notwithstanding, the thought-experiment of separately increasing β_i^- and β_i^+ for a fixed ω is instructive. Importantly, λ enters positively into the marginal utility from acquiring negative power, but the marginal utility from acquiring positive power is independent of λ. It follows that, as λ is increased, negative power becomes relatively more potent as a means to increase expected utility than is positive power.

2.4 Bargaining over Decision Rules

The decision rule of the EU Council of Ministers, $QM\,(4, 0.55, 0.65)$, was adopted as the consensual outcome of negotiations among all EU leaders. The consensual nature of the outcome not withstanding, the negotiations were intense in nature, with countries robustly defending their interests, and with a final agreement not reached until the early hours of the morning (Moberg, 2002). Accordingly, we model the outcome of these negotiations as the solution of a (generalized) Nash bargain among EU member states.

The formulation of a general bargaining problem over the set of all decision rules satisfying A0-A3 is analytically intractable. Instead, we exploit the observation that EU leaders chose a decision rule corresponding to a special case of $QM(q_A, q_F, q_P)$ to restrict attention to the problem of bargaining over the three threshold quantities $\{q_A, q_F, q_P\}$ that define the QM rule.

What would have been the likely outcome if EU leaders had been unable to reach an agreement? Here we suppose that, in the absence of an agreement, EU leaders would resort to the unanimity decision rule, under which a motion passes if and only if all countries vote for. Uniquely among decision rules, the unanimity rule ensures that no country can ever experience a loss, making it focal as a fall-back option. Consistent with this idea, EU leaders...

If the unanimity decision rule is adopted, each country obtains a (common) expected utility

$$\mathbb{E}(U_D) = p^N V\left(W^F\right), \tag{6}$$

where equation (6) follows from the observation that only in the event that all countries vote for, which occurs with probability p^N, is an affirmative outcome reached. In all other instances, the motion fails and the status quo is preserved.

While the unanimity rule maximizes negative power (giving full insurance against the adoption of harmful motions), it comes at the cost of minimizing positive power. This sacrifice of positive power will be perceived as gainful by a head of government who is sufficiently loss averse, but is perceived as harmful otherwise. Comparing (4) and (6), country i prefers the unanimity rule to $QM(q_A, q_F, q_P)$ if

$$\lambda > \frac{p\left\{\omega + [1-\omega]\,\beta_i^+\right\} - p^N}{[1-p]\,\omega\left[1-\beta_i^-\right]}\frac{V\left(W^F\right)}{V\left(W^A\right)} \equiv \tilde{\lambda}_i(q_A, q_F, q_P). \tag{7}$$

Let $\overline{\lambda}_i \equiv \max_{\{q_A, q_F, q_P\}} \tilde{\lambda}_i(q_A, q_F, q_P)$ be the maximum value of $\tilde{\lambda}_i(q_A, q_F, q_P)$, such that if $\lambda > \overline{\lambda}_i$ there is no choice of thresholds $\{q_A, q_F, q_P\}$ that would make country i prefer a QM rule. Defining $\underline{\lambda} \equiv \min_{j \in \mathcal{N}}\left\{\overline{\lambda}_j\right\}$ as the smallest such $\overline{\lambda}_i$ across countries, we then have:

Proposition 2

(i) If $\lambda < \underline{\lambda}$ the bargaining outcome is described by the solution to the problem

$$\max_{\{q_A, q_F, q_P\}} \prod_{j \in \mathcal{N}} \left[\mathbb{E}\left(U_j - U_D\right)\right]^{\tau_j}; \qquad \sum_{j \in \mathcal{N}} \tau_j = 1. \tag{8}$$

(ii) If $\lambda \geq \underline{\lambda}$ the bargaining outcome is the disagreement point.

Proposition 2 establishes the predicted bargaining outcomes. If $\lambda < \underline{\lambda}$ there exists a decision rule $QM(q_A, q_F, q_P)$ that yields a Pareto improvement relative to the disagreement point, in which case countries are predicted to bargain to the Nash bargaining solution. Conversely, if $\lambda \geq \underline{\lambda}$ then, for every set of thresholds $\{q_A, q_F, q_P\}$ there exists at least one country that is better-off under the unanimity rule than under $QM(q_A, q_F, q_P)$. In this case, any such country will force implementation of the disagreement point.

3 Estimation

In this section we use the model of the previous section to analyze the choice by EU leaders of the QM rule contained in the 2007 Treaty of Lisbon, and which entered into force on 1st November 2014.[10]

3.1 Identification of λ

To motivate our approach to measuring the coefficient of loss aversion, we now prove a Lemma:

Lemma 1 *The ratio β_i^- / β_i^+ is independent of i.*

Lemma 1 establishes that the ratio $R \equiv \beta_i^- / \beta_i^+$ is common across countries. The R chosen by EU leaders captures their preference for negative relative to positive power – $R > 1$ indicating a stronger concern for negative power, $R < 1$ indicating a stronger concern for positive power, and $R = 1$ indicating an equality of concern for each type of power. The intuition behind our approach is that the chosen value of R is driven by the loss aversion parameter λ. Higher values of λ cause more weight to be placed on negative power in the

[10] Up until 31st March 2017, however, it was still possible for member states to request that votes take place under the "old" QM rule adopted in the Treaty of Nice.

expected utility function, leading the R chosen by EU leaders to increase, albeit small degrees of numerical coarseness may result in small-scale local violations of this general pattern (as we shall see in Section 4).

Via this link of R to λ, we are able to infer the value of λ held by EU leaders from the observed R implied by their choice of decision rule. Formally, we look for the unique value of λ (denoted λ^*) at which $R(\lambda)$ at the Nash bargaining solution corresponds to the observed R of the decision rule actually chosen by EU leaders ($R_{Lisbon} \equiv R_{QM(4,0.55,0.65)}$). Let R^* be the value of R at the Nash bargaining solution. Then λ^* is implicitly defined by the equality

$$R^*(\lambda^*) = R_{Lisbon}.$$

3.2 Implementation

Bargaining weights

The outcome of a bargaining process may be affected by a range of factors in addition to those captured by the decision rule. As Bailer (2010) discusses in the EU context, a range of other factors, including bargaining skill, economic might, domestic constraints, information, and institutional power, plausibly play a role. Our model allows for these features to be captured within the set of bargaining weights, $\{\tau_j\}_{j\in\mathcal{N}}$. We now describe how we infer these weights from the observed choice behavior of EU leaders:

Lemma 2 *At a solution to (8) it holds that*

$$\tau_i \approx \frac{\mathbb{E}(U_i - U_D)}{\sum_{j\in\mathcal{N}}[\mathbb{E}(U_j - U_D)]}$$

The proof of Lemma 2 demonstrates that, were all the variables in the bargaining problem in (8) defined on the set of real numbers, the approximation given in the Lemma would hold exactly. The approximation in the Lemma arises as our measures of positive and negative power can take values on only a subset of the rational numbers.

It follows from Lemma 2 that estimates of the bargaining weights can be inferred by examining the shares of the surplus that accrue to each member state under the Lisbon decision rule $QM(4, 0.55, 0.65)$ chosen by EU leaders. As, however, expected utility is a function of λ, the inferred shares depend on the assumed level of loss aversion. Hence, for a given λ, we compute an estimate of τ_i, denoted $\hat{\tau}_i$, as

$$\hat{\tau}_i(\lambda) = \frac{\mathbb{E}_{Lisbon}\left(U_i(\lambda) - U_D\right)}{\sum_{j \in \mathcal{N}} \left[\mathbb{E}_{Lisbon}\left(U_j(\lambda) - U_D\right)\right]}.$$

Voting probabilities

From behind a veil of ignorance as to the motion to be voted on and the preferences of the voters, it is conventional to assume that a voter is equally likely to vote for or *against* ($p = 0.5$). In this context, however, we believe there are a-priori grounds to suppose that, under the QM rule, countries are more likely to support a motion than to oppose it ($p > 0.5$). The argument here is one of selection: as well as choosing a QM rule EU leaders also choose the policy areas to which it will apply. In particular, it is an established practice within the EU that, in some policy areas, the CoM votes under the unanimity rule.[11] An implication of Proposition 2 is then that the QM rule (Nash bargaining solution) is applied to those areas with a sufficiently high a-priori expectation of consensus (p high enough that $\lambda < \underline{\lambda}(p)$), while the unanimity rule (disagreement point) is chosen for policy areas expected to achieve sufficiently little consensus (p low enough that $\lambda \geq \underline{\lambda}(p)$).

Voting data underscore the very high observed levels of consensus in voting under a QM rule. Using data provided by VoteWatch Europe (http://www.votewatch.eu), an independent not-for-profit organization, we examine voting outcomes under the QM rule that applied at the time EU leaders were negotiating the Lisbon Treaty. This was the QM rule in the Treaty of Nice that applied between February 2003 and October 2014.[12] In the period covered by the data – all CoM votes under the Nice QM rule beyond (TBC) – the proportion of votes cast that were votes for, stands at 97.29 percent.[13] Hosli (2007) reports a similarly high rate of 97.96 percent in data on CoM votes covering 1995-2004, and initial estimates under

[11] Policy areas currently subject to the unanimity rule include common foreign and security policy, EU membership, the granting of new rights to EU citizens, and the harmonization of national legislation in the field of social security and social protection.

[12] The QM rule in the Nice Treaty entailed three criteria for decisions to be adopted. It required that 74 percent of member states' weighted votes be cast in favor, and a majority of member states to vote in favor. Last, those in favor were required to represent at least 62 percent of the EU's total population.

[13] In practice the CM will sometimes (?? percent of motions) vote more than once on a motion. The majority (99 percent) of the uses of the QM rule in our data occur under the ordinary legislative procedure (previously co-decision) under which the European Parliament may propose amendments to legislation passed by the CM at first reading, thereby requiring further rounds of voting in the CM. Where multiple rounds of voting occur we restrict attention to the final round of voting, for in earlier rounds of voting the vote was over legislation not in its final form. We also exclude a small number of motions (??) on which not all CM members participated in voting (e.g. acts adopted only by Euro area or Schengen member states).

the Lisbon QMV rule (based on VoteWatch data between (TBC)) put the proportion of for votes at 97.80 percent.[14]

We use the observed rates of voting for under the Nice QM rule to estimate the parameter p, which is the a-priori probability that a motion is gainful to a country. Here we suppose that the p held by EU leaders is a rational reflection of the empirical patterns of for-voting behavior that existed under the QM rule at the time the negotiations were taking place.[15] A naïve approach to the estimation of p is to equate it directly to the observed proportion of for-votes. A notable feature of our data that augurs against such an approach, however, is that no vote in the CoM is observed to $fail$ under the QM rule (Nice or Lisbon). This appears indicative of a tendency within the EU Commission (and other international bodies) to bring forward only proposals that are expected to $pass$ under the relevant decision rule. By contrast, our model envisages an environment in which motions are not filtered endogenously in the shadow of the decision rule. Accordingly, to align the model with actual practice in the EU, we interpret the empirical proportion of votes that are for as an estimate of the conditional probability $\Pr(i \in F|pass)$ rather than of the unconditional probability $\Pr(i \in F)$. Under the Nice QM rule some 97.29 percent of votes are for votes. We use this statistic to back-out the implied value of $p \equiv \Pr(i \in F)$. In particular, p is the solution to the equality

$$\frac{p}{1 - \omega_{Nice}(p)} = \Pr(i \in F|pass) = 0.9729. \tag{9}$$

We compute the solution to the equality in (9) as $p = 0.97287$. We use this estimate in what follows.

Monetary payoffs

From behind a veil of ignorance, we know of no compelling reason for assigning different scales to the monetary payoffs $\{W^A, W^F\}$. In such a circumstance, Bernoulli's principle of insufficient reason advocates that these quantities should be set on the same scale. Accordingly, we set $W^F = W^A = W$, so that the loss from implementing an unfavorable motion is equivalent in magnitude to the gain from implementing a favorable motion.

[14] For further discussion of voting patterns in the CM see Hosli *et al.* (2018).

[15] Implicitly, therefore, we assume that EU leaders did not anticipate rates of for-voting to materially change (relative to the Nice QM rule) under the new Lisbon QM rule they were in the business of negotiating. As empirical rates of for-voting in the CM have indeed been virtually unchanged by the adoption of the Lisbon QM rule, this supposition does not seem unreasonable.

A notable implication of this specification is that the utility function, $V(W)$, enters both the expected utility in Proposition 1, and the disagreement payoff in (6), as a multiplicative factor. It therefore enters the Nash product as a multiplicative factor, and consequently plays no role in the determination of the bargaining solution. Our estimate of the coefficient of loss aversion is, therefore, independent of assumed risk preferences.

Computational approach

We solve the problem in (8) using numerical methods. For a given choice of λ we perform initially a grid search over $11 \times 13 \times 13$ unique points in $\{q_A, q_F, q_P\}$-space, from which a set of potential local maxima are identified.[16] To locate each local maximum exactly, and ultimately infer which of these local maxima is the global maximum, we employ a direct search (compass) algorithm around each potential local maximum (see Kolda *et al.*, 2003, for a review of these methods).[17]

Proceeding in this way, to obtain $R^*(\lambda)$ for a single λ we must compute $R(q_A, q_F, q_P)$ over 8000 times. Moreover, the results we present in the next section are based on computing $R(\lambda)$ for some (TBC) unique values of λ. For this approach to be feasible, therefore, standard approaches to the computation of $\left\{\beta_i^-, \beta_i^+, \omega\right\}$ cannot be employed. A single brute force computation of either β_i^- or β_i^+ for the then 27-member CoM requires checking the outcome of some 2^{27} possible vote configurations.[18] Moreover, the scale of the population data thwarts the efficiency of generating functions (see Bilbao *et al.*, 2000) as an alternative exact approach.[19] Accordingly, we develop a novel approach to this computational problem (Appendix 2).[20]

4 Results

Our findings for the coefficient of loss aversion are depicted in Figure 2. Panel (a) of the figure shows the function $R(\lambda)$ for λ on a broad domain encompassing all points such that $\lambda \leq \underline{\lambda}$.

[16] The grid search computes the Nash product in (8) for $q_A \in \{1, 2, \ldots, 13\}$, $q_F \in \{14, 15, \ldots 27\}$, and $q_P \in \{0.5, 0.55, \ldots, 1\}$.

[17] We employ the method in Lewis *et al.* (2007) when searching close to one or more parameter boundaries.

[18] Croatia, currently the newest member of the now 28-state EU, did not join until July 2013.

[19] The generating function approach can, however, be used as an approximation method if the country populations are scaled-down and then rounded to the nearest integer.

[20] Although we do not dwell on this methodological development here, we note that the approach to the computation of $\{\beta_i^-, \beta_i^+\}$ outlined in Appendix 2 has applicability to the study of a range of other large-N voting games for which existing approaches are inefficient.

Panel (b) of the Figure "zooms in" on $R(\lambda)$ around the point $\lambda = \lambda^*$. In panel (a) we see that, at $\lambda = 1$ the Nash bargaining solution implies an overwhelming preference for positive over negative power. Recalling that motions voted on under the QM rule are overwhelmingly likely to be gainful, it should not be surprising that the Pareto optimum identified by the Nash bargaining solution is geared toward attaining the outcome *pass*. As the value of λ is incremented above one the bargaining solution begins to give more relative weight to negative power, with positive and negative power attaining parity ($R(\lambda) = 1$) at around $\lambda = 5$. As λ continues to be raised $R(\lambda)$ continues to rise in a largely stepped fashion. The critical value $\underline{\lambda}$ is found as $\underline{\lambda} = 25.9$, at which point Malta (the least populous EU member) is sufficiently loss averse that it prefers the unanimity rule to any QM rule. Accordingly, for $\lambda \geq \underline{\lambda}$ the unanimity rule applies; under this rule negative power is approximately 40 times stronger than is positive power ($R = 40$).

Figure 2 – see p. 28

To obtain an estimate of λ we look for the intersection of $R(\lambda)$ with R_{Lisbon}, where the latter computes as $R_{Lisbon} = 0.0045$. As seen in panel (b), the intersection arises at $\lambda = \lambda^* = 4.40$. This finding implies that the potential for losses arising from the passing of a motion are given around 4.4 times as much psychological weight as are the potential for gains. EU leaders are loss averse.

5 Discussion and Conclusion

In this study we use the way in which world leaders design voting systems for international institutions to infer their coefficient of loss aversion. In particular, we consider the design of the QM rule in the Treaty of Lisbon, which was negotiated by EU leaders in 2007. Our findings suggest that world leaders are indeed loss averse: the potential for losses are given around 4.4 times as much psychological weight as is the potential for equivalent gains. Our approach models the negotiations over the Lisbon rule as a (Nash) bargain, and estimates the coefficient of loss aversion independently of risk preferences.

Designing design rules for international organizations inherently entails high-stakes, and heads of government are highly experienced decisonmakers. These features might suggest that heads of government would not exhibit loss aversion. Our findings go contrary this suggestion, however. Indeed, to the extent that our estimate of the coefficient of loss aversion is higher than is typically found in the literature, heads of government may be more prone to loss aversion than is than the population at large. Our findings are, however, consistent with a literature exposing that even experts remain prone to behavioral biases (Foellmi *et al.*, 2016; Pope and Schweitzer, 2011). It is also possible that heads of government might be more prone to loss aversion in the pressure-cooker atmosphere surrounding the negotiation of a high-profile international decision rule. There is some evidence that even experienced decisionmakers may "choke" when faced with making highly consequential decisions, and thereby exhibit greater behavioral bias than they would over more routine decisions with lower stakes (Baumeister, 1984; Ariely *et al.*, 2009; Dohmen, 2008).

Loss aversion leads to the design of voting rules that set the bar for affirmative action inefficiently high. Welfare improving policies that would be enacted in a counterfactual world without loss aversion may not be enacted in a world with loss aversion. In the EU context, two distinct effects are discernible, which align conceptually with the notions of intensive and extensive margins. First, at the intensive margin, our analysis predicts that, if EU heads of government were not loss averse, they would have designed a QM rule with less stringent thresholds for motions to pass. Second, at the extensive margin, in the absence of loss aversion, EU heads of government would have been willing to utilize the QM rule for decisionmaking over range of policy issues that are at present subject to the unanimity rule. Taking these effects in turn, under the conditions of our stylized model, 0.023 percent of motions are predicted to fail under the Lisbon QM rule. Were EU leaders loss neutral our model predicts that the QM rule they would hypothetically design fails less than 0.0001 percent of motions. While this difference is significant in relative terms, in absolute terms the effect is small. This is simply because QM is only utilized in domains with very high rates of consensus, so there is limited scope to further reduce already tiny predicted failure rates.

To investigate the second (extensive) effect, we give a reinterpretation of Proposition 2. Proposition 2 is predicated on the existence of a known p, and proceeds to characterize the nature of the bargaining outcome as a function of λ. It is equally possible, however, to fix λ (at $\lambda = \lambda^* = 4.4$) and then characterize the bargaining outcome as a function of p. This leads to a threshold level of p, $\underline{p}(\lambda) \in (0, 1)$, with an analogous interpretation to the threshold $\underline{\lambda}$. Intuitively, a lower value of p implies an increased probability that a country will be required to vote on motions that, if passed, would cause it harm. This increases the attractiveness of the unanimity rule relative to all other decision rules. For a sufficiently low p, i.e., $p \leq \underline{p}(\lambda)$, there exists no QM rule that is a Pareto improvement relative to the disagreement point, causing bargaining to break down and the implementation of the disagreement point. Accordingly, if $p > \underline{p}(\lambda)$ a QM rule is chosen according to the solution to the problem in (8), and the unanimity rule prevails otherwise.

We compare $\underline{p}(\lambda^*)$ with $\underline{p}(1)$. In particular, policy areas for which $\underline{p}(1) < p < \underline{p}(\lambda^*)$ are those areas in which loss averse EU leaders are predicted to choose the unanimity rule, whereas loss neutral EU leaders are predicted to choose the Lisbon QM rule. Using the computational approach described in section 3.2 we obtain $\underline{p}(1) = TBC$ and $\underline{p}(\lambda^*) = TBC$. Accordingly, $\underline{p}(\lambda^*)$ represents a relative increase of (TBC) percent compared to $\underline{p}(1)$. As the EU has 21 broad policy areas under which the CoM votes, if the relative increase in the number of policy areas utilizing the Lisbon QM rule were to match the relative increase in $\underline{p}$, then approximately (TBC) policy areas currently utilizing the unanimity rule might instead utilize the Lisbon QM rule were EU leaders loss neutral.[21] Such a shift would have potentially profound implications for European cooperation in areas such as taxation, social security or social protection, foreign and common defence policy and operational police cooperation.

Taking a broader perspective, given that voting rules are not only a feature of EU decisionmaking, but are pervasive in other international, national and local contexts, the wider public policy implications of our analysis are potentially very significant. In an effort to prevent behavioral biases distorting the design of decision rules we therefore echo the call of Hosli and Machover (2004) for a dialogue between academics and practitioners in order to ensure that expert advice on decision rules and their effects is available to the decisionmakers called upon to negotiate them.

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[21] As, however, we know of no published estimates of the quantity p across policy areas, how many such policy areas lie in the interval $(\underline{p}(1), \underline{p}(\lambda^*))$ we cannot establish with certainty.

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Appendix 1

Proof of Proposition 1. Using (3) in (4) gives

$$\mathbb{E}(U_i) = \Pr(i \in F \cap pass) V\left(W^F\right) - \lambda \Pr(i \notin F \cap pass) V\left(W_i^A\right).$$

By the multiplication axiom of conditional probabilities, we then have

$$\begin{aligned} \mathbb{E}(U_i) &= \Pr(i \in F)\Pr(pass|i \in F) V\left(W^F\right) - \lambda \Pr(i \notin F)\Pr(pass|i \notin F) V\left(W^A\right) \\ &= \Pr(i \in F)\Pr(pass|i \in F) V\left(W^F\right) - \lambda \Pr(i \notin F)\left[1 - \Pr(fail|i \notin F)\right] V\left(W^A\right). \end{aligned}$$

Substituting $\Pr(i \in F) = p$, this reduces to

$$\mathbb{E}(U_i) = p\Pr(pass|i \in F) V\left(W^F\right) - \lambda\left[1-p\right]\left[1 - \Pr(fail|i \notin F)\right] V\left(W^A\right).$$

Finally, using (1) to replace the terms $\Pr(pass|i \in F)$ and $\Pr(fail|i \notin F)$, we obtain the proposition. ■

Proof of Lemma 1. Define

$$\beta_i = \omega\beta_i^- + [1-\omega]\,\beta_i^+. \tag{A.1}$$

According to (A.1), β_i is constructed as the sum of (i) the probability a country can turn an otherwise winning coalition into a losing one by switching its vote from for to *against* ($\omega\beta_i^-$); and (ii) the probability that a country can turn an otherwise losing coalition into a winning one by switching its vote from *against* to for ($[1-\omega]\,\beta_i^+$). When country i is able to change to outcome of a vote by switching its vote, it is said to be *critical* ($i \in C$). Thus β_i is simply the probability that i is critical: $\beta_i = \Pr(i \in C)$.

We now construct expressions for $\Pr(pass|i \in F)$ and $\Pr(fail|i \notin F)$. By Bayes' rule we have

$$\Pr(pass|i \in F) = \frac{\Pr(pass)\Pr(i \in F|pass)}{\Pr(i \in F)} = \frac{\omega\Pr(i \in F|pass)}{p}; \tag{A.2}$$

$$\Pr(fail|i \notin F) = \frac{\Pr(fail)\Pr(i \notin F|fail)}{\Pr(i \notin F)} = \frac{[1-\omega]\Pr(i \notin F|fail)}{1-p}. \tag{A.3}$$

Then, again by Bayes' rule,

$$\Pr(i \in F|pass) = \frac{\Pr(i \in (C \cup F) \cap pass) + \Pr(i \in (F \setminus C) \cap pass)}{\Pr(pass)}. \tag{A.4}$$

Noting that $\Pr(i \in (C \cup F) \cap pass) = \Pr(i \in C \cup F)$, (A.4) reduces to

$$\Pr(i \in F|pass) = \frac{\Pr(i \in C \cup F) + \Pr(i \in (F \setminus C) \cap pass)}{\Pr(pass)} \tag{A.5}$$

Noting next that $i \in C$ and $i \in F$ are statistically independent events, (A.5) reduces to

$$\Pr(i \in F|pass) = \frac{\Pr(i \in F)\left[\Pr(i \in C) + \Pr(i \notin C \cap pass)\right]}{\Pr(pass)} = \frac{p\left[\beta_i + \Pr(i \notin C \cap pass)\right]}{\omega} \tag{A.6}$$

Using analogous steps we also obtain

$$\Pr(i \notin F|fail) = \frac{[1-p]\left[\beta_i + \Pr\left(i \notin C \cap fail\right)\right]}{1-\omega}. \tag{A.7}$$

Substituting (A.6) into (A.2) and (A.7) into (A.3) we obtain

$$\Pr\left(pass|i \in F\right) = \frac{\omega \Pr(i \in F|pass)}{p} = \beta_i + \Pr\left(i \notin C \cap pass\right); \tag{A.8}$$

$$\Pr\left(fail|i \notin F\right) = \frac{[1-\omega]\Pr(i \notin F|fail)}{1-p} = \beta_i + \Pr\left(i \notin C \cap fail\right). \tag{A.9}$$

By definition, we have

$$\begin{aligned} \Pr\left(pass\right) &\equiv \Pr\left(i \notin C \cap pass\right) + \Pr\left(i \in (C \cup F) \cap pass\right) + \Pr\left(i \in (C \setminus F) \cap pass\right) \\ &= \Pr\left(i \notin C \cap pass\right) + \Pr\left(i \in C \cup F\right) \\ &= \Pr\left(i \notin C \cap pass\right) + \Pr\left(i \in F\right)\Pr\left(i \in C\right). \end{aligned} \tag{A.10}$$

So, rearranging (A.10),

$$\Pr\left(i \notin C \cap pass\right) = \Pr\left(pass\right) - p\beta_i = \omega - p\beta_i. \tag{A.11}$$

By analogous steps we obtain

$$\Pr\left(i \notin C \cap fail\right) = \Pr\left(fail\right) - [1-p]\,\beta_i = 1 - \omega - [1-p]\,\beta_i. \tag{A.12}$$

Substituting (A.11) into (A.8) and (A.12) into (A.9) we obtain

$$\Pr\left(pass|i \in F\right) = \beta_i + \Pr\left(i \notin C \cap pass\right) = \omega + [1-p]\,\beta_i; \tag{A.13}$$

$$\Pr\left(fail|i \notin F\right) = \beta_i + \Pr\left(i \notin C \cap fail\right) = 1 - \omega + p\beta_i. \tag{A.14}$$

Substituting (A.13) and (A.14) into (1) we obtain

$$\beta_i^+ = \left[\frac{1-p}{1-\omega}\right]\beta_i; \qquad \beta_i^- = \left[\frac{p}{\omega}\right]\beta_i; \tag{A.15}$$

such that positive and negative power, β_i^+ and β_i^-, are seen to be directly proportional to β_i. We then have that

$$\frac{\beta_i^-}{\beta_i^+} = \frac{\left[\frac{p}{\omega}\right]\beta_i}{\left[\frac{1-p}{1-\omega}\right]\beta_i} = \frac{p}{1-p}\frac{1-\omega}{\omega},$$

which does not depend on i. ■

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Proof of Lemma 2. We begin by assuming (falsely), that the variables in the bargaining problem are all defined on the set of real numbers (such that we can always increment and decrement at the margin). At a Nash bargaining solution, a marginal increase in $\mathbb{E}\left(U_i\right)$

[22] That R is independent of i follows from (**??**). As ω, the left-side, is a constant, so must be the right-side.

and an offsetting decrease in $\mathbb{E}(U_j)$, $j \neq i$, must leave the value of the Nash maximand unchanged:

$$\frac{\tau_i}{\mathbb{E}(\Delta U_i)} - \frac{\tau_j}{\mathbb{E}(\Delta U_j)} = 0; \qquad j \neq i. \tag{A.16}$$

The $N-1$ equations given by setting $i = 1$ and $j = 2, \ldots, N$ in (A.16), coupled with the equality $\sum_{k \in \mathcal{N}} \tau_k = 1$, together give a system of N equations in N unknowns, $\{\tau_k\}_{k \in \mathcal{N}}$, with a unique solution given by

$$\tau_i = \frac{\mathbb{E}(\Delta U_i)}{\sum_{k \in \mathcal{N}} \mathbb{E}(\Delta U_k)}. \tag{A.17}$$

Thus, for real variables, at a Nash bargaining solution, the weight τ_i corresponds to i's share of the utility surplus. Noting that $\{\beta^-, \beta^+, \omega\}$ are not defined on the real line, but instead are restricted to a subset of the rational numbers, the equality in (A.17) does not hold exactly in our context. The closeness of the approximation is a function of the density of $\{\beta^-, \beta^+, \omega\}$ on the set of rational numbers. As we consider a (large) 27 player game, $\{\beta^-, \beta^+, \omega\}$ are relatively dense: at the estimate of $\lambda = 4.4$ the maximum relative deviation from (A.17) is only (TBC) percent. ■

Appendix 2: Computing Positive and Negative Power

This Appendix is not yet completed, but will be ready in advance of the conference.

Figures

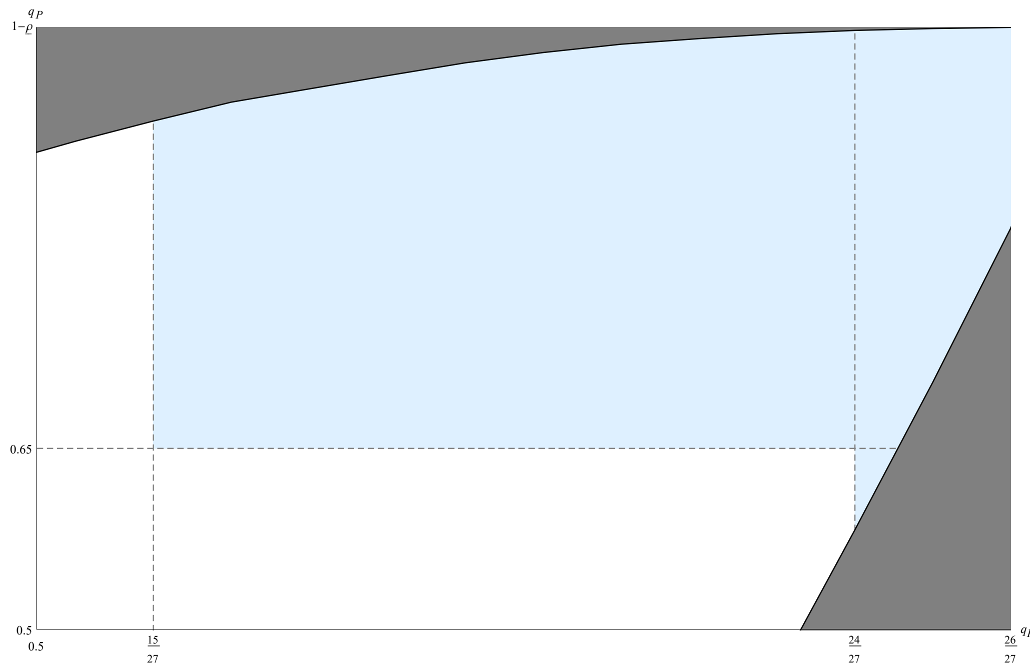
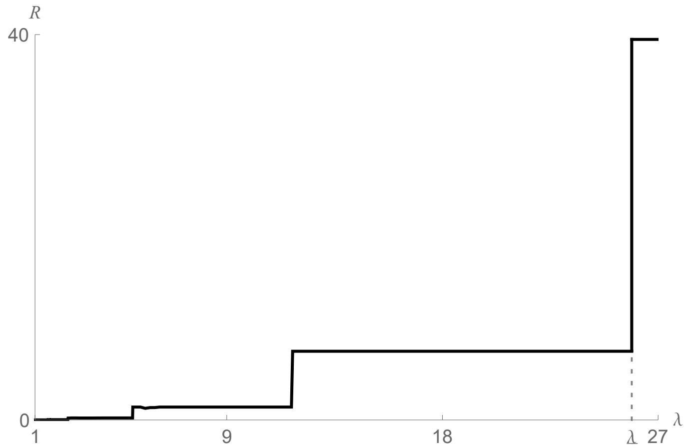
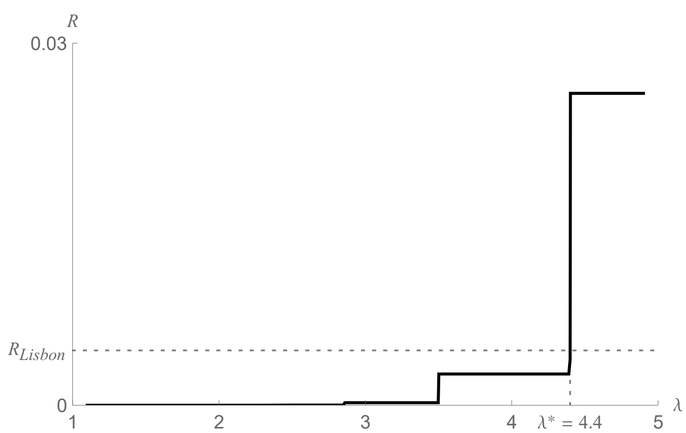


Figure 1: Visual representation of the set of winning coalitions under the Lisbon QM decision rule. The area shaded gray is infeasible. The area shaded blue is the set of winning coalitions.



(a) R at the bargaining outcome, as a function of λ.



(b) R at the bargaining outcome in the neighborhood of $\lambda = \lambda^*$.

Figure 2: The bargaining outcome for different values of λ.