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Contracting under uncertainty: A principal–agent model with ambiguity averse parties

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ABSTRACT

We introduce linguistic ambiguity into a principal–agent contracting framework. Contracts are drafted in a common language. Nevertheless, the principal and the agent may ultimately disagree about the terms of the contract that apply *ex post*. We presume that both parties are ambiguity averse and for tractability reasons that their preferences take a recursive constant absolute risk averse (RCARA) form. We consider various dispute resolution regimes and analyze how the optimal dispute resolution regime depends on the ambiguity attitudes of the parties. We also provide an axiomatization of the class of RCARA preferences.

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1. Introduction

The problem of ambiguity in contracts has received a good deal of attention from both economists (beginning with Hogarth and Kunreuther, 1989) and legal scholars (for example Thomas, 2006). Fittingly, however, the term 'ambiguity' is itself ambiguous.

In the legal studies literature, as in ordinary language, the term 'ambiguity' is used to describe statements which are open to multiple interpretations. The key concern is which interpretation should be preferred in construing the provisions of contracts. We will refer to 'linguistic ambiguity' to describe this usage. Grant et al. (2012, 2014) and Halpern and Kets (2015) have developed models of linguistic ambiguity in game theoretic settings. Li (2017) has used empirical methods to elicit ambiguity attitudes when the source of ambiguity is linguistic.

In economics and decision theory, 'ambiguity' refers to decision problems in which the probability distribution over states of the world is itself unknown or uncertain. The term is derived from Ellsberg (1961), who uses it to describe "the nature of one's information concerning the relative likelihood of events ... What is at issue might be called the ambiguity of this information, a quality depending on the amount, type, reliability and 'unanimity' of information and giving rise to one's degree of 'confidence' in an estimate of relative likelihoods" (p. 657).

In subsequent decision-theoretic writing, the referent of the term 'ambiguity' has shifted, from the information used to derive relative likelihoods to the likelihoods themselves. We will therefore use the term 'probabilistic ambiguity' to describe the decision-theoretic usage. A crucial distinction between probabilistic and linguistic ambiguity is that the former is typically interpreted in terms of individual beliefs and preferences, while the latter refers naturally to communication between

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people. In a contracting setting, probabilistic ambiguity is most commonly treated as a property of risks, as perceived by an individual party, while linguistic ambiguity is a property of multiple interpretations of the contract by the parties.

We introduce linguistic ambiguity into a principal–agent contracting framework. Contracts are written in a common language that can express a complete set of mutually and exhaustive contingencies or statements. Each party receives a signal about which of these statements applies. Each party regards his or her own signal as unambiguous, while perceiving the other party's signal to be ambiguous. Although the contractual language is common, the two parties may disagree about its interpretation, that is, which statement applies. This potentially gives rise to contractual disputes. Our focus here is not on the traditional trade-off between incentives and risk, but rather on how different ambiguity and risk attitudes of the parties influence the optimal choice of contracts.

A particularly apt illustration of how linguistic ambiguity can lead to contractual disputes appears in the 2015 Steven Spielberg cold-war thriller "Bridge of Spies". Early in the film, the main protagonist, Jim Donovan, a corporate lawyer (played by Tom Hanks) is seated in a bar engaged in conversation with another lawyer, Bob Bates. They are discussing a claim brought against Jim's client, an insurance company. The company had issued a car-insurance policy to a motorist who subsequently lost control of his car and hit five motorcyclists. The policy limits the company's liability to $100,000 per accident. Bob Bates, representing the five motorcyclists, confidently asserts, "clearly it's five things ... it's self-evident" and so contends the company is liable for up to $500,000. But Jim sees things differently, arguing that "one thing happened, not five things." Thus although both are reading the same contract there is ambiguity about their interpretation of what constitutes "an accident". Bob interprets it as five accidents while Jim sees it as only one. The type of ambiguity described here is what we want to capture in this paper. Notice that it is not probabilistic ambiguity since the two lawyers' disagreement is not about the likelihood of an event but rather the interpretation of which event occurred. Ultimately the consequence that results will depend on how such disputes are resolved. This in turn will affect the type of contracts that are offered and accepted by the parties and the relationship specific investments undertaken by the parties.

We model the agent as having access to a production technology that uses an input to produce a statement contingent output. We consider both statement-contingent contracts and output-contingent contracts. Statement-contingent contracts depend on the signal received. Since the principal and agent may receive different signals that may lead the parties to disagree about which provision of the contract should be operative, these contracts may be subject to disputes. Output-contingent contracts, on the other hand, preclude disputes, since the output is assumed to be observable by both parties.[1]

For statement-contingent contracts we consider various types of dispute resolution. Disputes may be resolved as a 'war-of-attrition' as in Grant et al. (2012, 2014). In this case, the potential loss from ambiguity is maximized and output-contingent contracts may be preferred. Under the standard legal doctrine of *contra proferentem*, however, disputes are resolved against the party who drew up the contract (in this case, the principal).[2] A third alternative, increasingly preferred by those drafting contracts, is to require disputes to be resolved by arbitration panels, which are generally seen as more favorable to principals. We refer to this as mandatory arbitration which we model under the polar assumption that ambiguity is always resolved in favor of the principal.

These are not the only possibilities. One might also envisage contracts that mix the dispute resolution regimes. In particular, taking the legal doctrine of contra proferentem as the default, the contract could specify the event in which the agent has agreed to set aside this doctrine and instead have any dispute resolved by mandatory arbitration. In order to avoid the possibility of a meta-dispute about which dispute resolution regime should operate, we argue that such an event should be *unambiguous* in a sense we define formally in the sequel.

We begin in Section 2 by formally developing the principal–agent framework outlined above. We assume each party's preferences admit a recursive constant absolute risk averse (RCARA) representation. These preferences are particularly tractable since they exhibit three important properties: an own-signal sure thing principle, a conditional sure thing principle and translation invariance. (In Appendix A we show these three properties characterize this class of preferences.) In Section 3 we explore what form contracts might take in this setting. Section 4 provides conditions for various cases in which different dispute resolution regimes are optimally chosen. To help explicate these results, in Section 5 we present an example in which the signal structure has a bivariate normal distribution. Finally, we offer some concluding comments.

2. A model of risk and ambiguity

2.1. The set-up

Two individuals or (potential) parties to a contract, A (an agent) and P (a principal), share a common language for expressing the contingencies or *statements* that can be included in any contract they can draft. We take the most refined set of mutually exclusive and exhaustive statements expressible in this language to correspond to the finite space S. Although they use the same language, the two parties may disagree as to which statement obtains. In particular, when A perceives

[1] In a principal–agent setting, Macleod (2003) considers ambiguity that arises from subjective evaluations of output. While this is distinct from the approach taken here, it also is a potential source of conflict and has implications for the design of optimal contracts.

[2] We thank Daniel Quiggin for bringing this doctrine to our attention. Board and Chung (2009) discuss this doctrine in terms of their object-based model of differential awareness.

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