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A behavioral definition of unforeseen contingencies

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Abstract

The paper proposes a choice-theoretic definition of an unforeseen event and a model of behavior that accommodates such events. The analysis presumes an individual who is aware of their unawareness, which explains why all unforeseen events in this paper are non-null. Relative to existing work, the main contribution is to establish a distinction between unforeseen events and events whose likelihood is ambiguous. This is achieved by adopting a dynamic choice setting.

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Keywords: Dynamic choice; Unforeseen events; Ambiguity aversion

1. Introduction

How does one model an individual who does not foresee all relevant contingencies? An important idea in the literature is that unforeseen contingencies are *a source of ambiguity about the distribution of outcomes* and that models of ambiguity aversion, suitably reinterpreted, can double up as models of unforeseen contingencies.[2] The intuition is simple: an individual who cannot think about the physical states of the world may still think about and try to assess the distribution

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[2] See Ghirardato (2001), Mukerji (1997), Epstein et al. (2007), and the survey by Dekel et al. (1998).

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of outcomes. After all, knowledge of the latter distribution is enough to compute the expected utility of any action. Ambiguity arises however because an individual who cannot imagine the physical states of the world would have no basis on which to assess the distribution of outcomes.

This paper argues that a distinction between ambiguity and unforeseen contingencies can be made in a dynamic setting. In such a setting it is not enough to imagine a single distribution over outcomes. Instead, the individual has to imagine the marginal distribution of outcomes within each period as well as the autocorrelations across periods. The key is that in imagining the latter, the individual may not have complete freedom: some of the autocorrelations are objectively fixed. Consider a payoff stream $(\tilde{x}_t, \tilde{x}_{t+1}, ...)$ such that all the relevant uncertainty resolves in period t and $\tilde{x}_t(\omega) \neq \tilde{x}_t(\omega')$ whenever the states ω and ω' are different. Then, $\tilde{x}_t$ and all subsequent payoffs $\tilde{x}_{t+k}$ are perfectly correlated: conditional on $\tilde{x}_t = x$, an individual who can conceptualize the event tree can infer all subsequent payoff realizations by tracing the unique branch of the tree that passes through x in period t. This is so even if the individual perceives the likelihood of some states ω to be ambiguous. By comparison, an individual who cannot conceptualize the event tree cannot make this inference.

The first contribution of the paper is formalize this argument, leading a choice-theoretic definition of an unforeseen event. Sections 2 presents a detailed example of this formalization, while Section 3 discusses some of its limitations. Here, it is important to highlight that the analysis is based on the implicit assumption that the individual is *aware* that there are contingencies he does not foresee. This awareness is seen in the fact that the unforeseen events in the paper are not null (probability zero) events.[3]

To better understand the preceding remarks, it is helpful to think of the individual in this paper as perceiving more uncertainty than there is, namely, as perceiving *uncertainty about the autocorrelations in payoffs*. The perception of such additional uncertainty is how unforeseen events affect behavior and become non-null: it distorts, and potentially lowers, the evaluation of any action that exposes the individual to unforeseen events.

A second contribution of the paper is to highlight a tension between unforeseen events and recursivity – the main assumption behind standard models of dynamic choice.[4] To stack the deck in favor of recursivity, consider an individual who understands that his period-t payoff $\tilde{x}_t$ can take the value x, even though he cannot imagine the physical contingency ω in which this happens. Recursivity requires that the individual can assess a continuation utility summarizing all the realizations x' that succeed x and that *this assessment be independent of any realizations x'' that do not succeed x*. But without knowing which realizations succeed which, this is impossible.

Finally, the paper proposes and axiomatizes a utility representation that can accommodate unforeseen events. Consider an individual who foresees only two events, E and its complement E^c, while the true state space is much finer. Then, a typical action would induce a payoff stream that is not measurable with respect to the individual's coarse perception of the world. In the representation of this paper, the individual evaluates such an action by coming up with a measurable approximation, which, in the present context, consists of a stream of outcomes the individual expects to attain conditional on E and another such stream conditional on E^c. Equipped with this approximation, later on called *the individual's subjective act*, and a belief about the likelihood of E, the individual computes discounted expected utility in the usual way. A key axiom in deriving this representation is a suitable modification of recursivity.

[3] An event A is null if changing the outcomes on A leaves the individual indifferent. See Section 5 for a formal definition and Sections 3 and 13 for further discussion pertaining to null events.

[4] See the example in Section 7 and Theorem 5 in Section 10.