



# Endogenous incompleteness of financial markets: The role of ambiguity and ambiguity aversion

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## ABSTRACT

Incompleteness of financial markets has been widely questioned in the literature, but traditional research has been mainly focused on the role of transaction costs and asymmetric information in determining such incompleteness. This paper, instead, focuses on agents' preferences, showing that the introduction of ambiguity and ambiguity aversion may induce investors to restrict their trading to a simpler set of assets, relative to which they are less likely to make errors.

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## 1. Introduction

Incompleteness of financial markets has been widely questioned in the literature, but traditional research has been mainly focused on the role of transaction costs and asymmetric information in determining such incompleteness. This paper, instead, focuses on agents' preferences, showing that the introduction of ambiguity and ambiguity aversion may induce investors to restrict their trading to a simpler set of assets, relative to which they are less likely to make errors.

Traditional finance theory assumes that agents are either expected (EU) or subjective expected (SEU) utility maximizers. That is, they choose among alternative investment opportunities by simply confronting the respective expected utility values, computed through a unique probability distribution, which might be objectively given (EU) or subjectively derived (SEU).

Experimental works in finance and in decisions contradict both EU and SEU predictions. In particular, one of the most popular evidence of people's systematic violation of (subjective) expected utility is described by Ellsberg's (1961) paradox, that provides a comparison of different attitudes of the same agent when facing alternative sources of uncertainty.

Broadly speaking, Ellsberg's experiment shows that people do not generally like situations in which they are not able to derive a unique probability distribution over the reference state space. These situations have become known as situations of *ambiguity*, and the general "dislike" for them as *ambiguity aversion*. This attitude cannot be reflected by SEU or EU models, since they do not allow agents to express their own degree of confidence about a probability distribution. In fact, under ambiguity, not only is the payoff deriving from the choice of an act uncertain, but also its expected value, since it can be evaluated using different probability distributions that are all plausible.

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Ambiguity aversion induces agents' prudent behavior which is reflected in the functional that represents each agent's preferences. A wide body of literature in decisions is dedicated to *multiple priors* approaches towards ambiguity, the most popular example of these being probably the multiple priors preferences (MEU) axiomatized by Gilboa and Schmeidler (1989). Gilboa and Schmeidler extend standard expected utility by representing preferences through a utility index and a set of additive probabilities, instead of a unique one, on the state space. Agents with MEU preferences rank payoffs according to the criterion:

$$f \succcurlyeq g \Leftrightarrow \min_{p \in C} \int u(f) dp \geq \min_{p \in C} \int u(g) dp$$

where  $u(\cdot)$  is a standard utility index, and  $C$  is a convex subset of the standard simplex over the state space  $\Omega$ .  $C$  is interpreted as the set of effective priors considered by the agents, and ambiguity is reflected in its multivalued nature. Decision makers express ambiguity aversion by assigning higher probabilities to unfavorable states, as reflected in the *min* operator.

Recent developments in the multiple prior approach involve variations of the Gilboa and Schmeidler's functional, including models that combine pessimism and optimism (Ghirardato et al., 2004), representations that account for a concern for robustness against model misspecification (Hansen and Sargent, 2001), and preferences that generalize MEU by weakening the set of underlying axioms (Maccheroni et al., 2006).

The emergence of decision theoretic models that are less narrow than (subjective) expected utility has induced the growth of new fields of research in which these models are applied in standard macroeconomic and finance contests, with the aim of achieving a better representation of reality.

In particular, behavioral finance tries to explain some financial phenomena that contradict standard theory by considering agents whose choices are normatively questionable, in the sense that they are incompatible with SEU (and obviously with EU as well).

One of these particular phenomena is considered here. More specifically, we generalize Mukerji and Tallon's analysis on endogenous incompleteness of financial markets with CEU maximizing agents (Mukerji and Tallon, 1999, 2001), to the case of variational preferences (Maccheroni et al., 2006).

As it is well known, in finance theory it is common to distinguish between the risk of price change due to the unique circumstances of a specific security (*idiosyncratic risk*), and those correlated to the overall market (*systematic risk*). Consequently, in the analysis that follows, we assume that assets' payoffs have an idiosyncratic component, meaning that the payoff of each risky asset is affected by the same shocks that hit the other assets and the endowment processes, and also by other factors that are specific to that particular asset. The idea behind this assumption is that, in real economies, firms' profits are typically affected, not only by aggregate (or at least sectorial) shocks, but also by other circumstances that are more peculiar to each individual firm.

The idiosyncratic risk is firm-specific, and should be at least reducible to arbitrarily low levels through diversification. In fact, standard diversification arguments (see for example Chamberlein, 1983; Chamberlein et al., 1983; Reisman, 1988) show that, in a (incomplete) typical bond-equity finance economy, the equilibrium allocation would approximate a complete market allocation. The possibility of hedging financial risk should induce agents with random income streams to trade, in order to reduce their exposure to the economic risk, and to obtain a smoother consumption profile across time and contingencies. Nevertheless, empirical evidence contradicts this prediction, showing that nonparticipation in financial markets is extremely relevant (see for example Campbell, 2006).

In this paper, we provide an explanation for under-diversification. More specifically, we show that, if agents exhibit variational preferences, ambiguity and ambiguity aversion may lead to a collapse in the trade of financial assets whose payoff is greatly affected by idiosyncratic risk. In particular, it is ambiguity about the idiosyncratic component of the risky payoffs which is responsible for the possible break down. It is worth noting that it is not ambiguity per se that generates no-trade, but the fact that agents evaluate the acts of selling and buying according to different probabilities. In fact, if agents are identical (same utility function and same attitude towards ambiguity), and, furthermore, if they consider the same prior, regardless the position held in the asset, trade will in principle occur, as in the SEU case.

Finally, by appropriately restricting the class of preferences under consideration, we show that, even when the number of available assets becomes arbitrarily large, agents with these particular variational preferences cannot benefit from diversification, and the market breaks down.

We emphasize that what is crucial in determining endogenous incompleteness is the fact that the set of effective priors is multivalued. More precisely, in a simplified two agents economy that we are going to consider, the sufficient condition for endogenous incompleteness is characterized through non-differentiability of the functional representation for variational preferences. Our result strongly relies on non-differentiability also in the more general economy. In particular, we show that for a specific class of differentiable variational preferences, namely the multiplier preferences introduced by Hansen and Sargent (2001), the sufficient condition for the absence of trade cannot hold.

In the simpler setting, when the analysis is restricted to the subclass of variational preferences that are compatible with the sufficient condition for trade-breakdown, two opposite tendencies can be identified. From one side, risk aversion and the great variation of endowment across states tend to generate trade for insurance purposes. On the other side, the great

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