



# Ambiguity aversion and stock market participation: An empirical analysis<sup>☆</sup>



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## ABSTRACT

Theoretical models of portfolio choice that incorporate ambiguity predict that investors' propensity to invest in equities is reduced when ambiguity in the stock market increases. Although this hypothesis stems from the extant theoretical literature, there is no empirical work examining whether it is supported in the data. We test this hypothesis, measuring participation using equity fund flows and ambiguity with dispersion in analyst forecasts about aggregate returns. Our results confirm this hypothesis, as we show that, controlling for other factors that affect flows, increases in ambiguity are associated with outflows from equity funds. Moreover, using data from the Survey of Consumer Finances, we find that increases in ambiguity significantly reduce the likelihood that the average household invests in equities.

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## 1. Introduction

Since the seminal work of Ellsberg (1961), research in experimental economics and psychology has shown that people tend to be averse to conditions of ambiguity, where the probabilities associated with different states of nature are unknown.<sup>1</sup> Several authors have argued that ambiguity is relevant to financial markets, since the probabilities that underlie the distribution of asset returns are not explicitly known. Motivated by this observation, the notion

of ambiguity has received several applications in finance.<sup>2</sup> A robust prediction from theoretical models of portfolio choice is that, in the presence of ambiguity, stock market participation tends to be lower than predicted from the basic EU model, and negatively related to changes in ambiguity in the market (i.e., Dow and Werlang, 1992; Maenhout, 2004; Cao et al., 2005; Garlappi et al., 2007; Easley and O'Hara, 2009; Epstein and Schneider, 2010). This prediction, however, remains untested in naturally-occurring, financial data. In this paper we fill this void by empirically testing the hypothesis.

The starting point for our analysis is the notion that for non-professional investors, the principal avenue for stock market participation is through mutual funds. The Investment Company Institute (ICI) estimates that in 2011, households owned 89% of the mutual fund industry (ICI Factbook, 2012). Therefore, flows in and out of mutual funds reflect the active reallocation decisions of individual investors, and thus provide a direct measure of stock market participation. We use two empirical proxies to capture these shifts: mutual fund net flows, i.e. the net cash flow into equity funds, and mutual fund exchanges, i.e. the switch of capital between funds of different asset classes that are managed by the same investment house. Whilst the first measure captures stock

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<sup>1</sup> Hsu et al. (2005) and Levy et al. (2010) present evidence that ambiguous situations produce a unique neurological fingerprint, suggesting that ambiguity aversion is rooted in the fundamentals of human cognition. See Camerer and Weber (1992) and Keren and Gervitsen (1999) for reviews of the evidence on ambiguity aversion.

<sup>2</sup> For reviews of this literature see Mukerji and Tallon (2001), Epstein and Schneider (2010) and Guidolin and Rinaldi (2013).

market participation in absolute terms, the second, proposed by Ben-Rephael et al. (2012), provides a stock-market participation metric that is relative to other asset classes.

To test the hypothesis we require an empirical measure of ambiguity. To this end we rely on the measure proposed in a recent study by Anderson et al. (2009), which is based on dispersion in analysts' forecasts using data from the Survey of Professional Forecasters (SPF), issued by the Federal Reserve. The SPF contains quarterly forecasts of GDP growth and inflation from different analysts, and following Anderson et al. (2009) we use the Gordon Growth Model to derive a forecast for aggregate stock market returns for each analyst.<sup>3</sup> When dispersion among analysts regarding the future performance of stock markets is high, ambiguity is also likely to be high since experts have arrived at conflicting views regarding the fundamentals of the economy. In these conditions investors can be thought to face multiple plausible distributions of expected equity returns, which indicate higher ambiguity.

This approach of measuring ambiguity, which has been employed by several other studies in finance (Ulrich, 2013; Drechsler, 2013; Shi, 2013), corresponds closely to the original definitions provided by Ellsberg (1961), who in his seminal paper noted that "... it should be possible to identify "objectively" some situations likely to present high ambiguity, by noting situations where ... expressed expectations of different individuals differ widely;" Ellsberg (1961, p. 660). Thus, according to Ellsberg (1961), when different individuals arrive at conflicting views (i.e., when dispersion is high), the underlying distribution can be described as more ambiguous. Moreover, this approach is in line with the asset pricing literature that models ambiguity as uncertainty about the model generating returns (e.g., Hansen and Sargent, 2001). Since each individual analyst relies on his preferred model to make a prediction, high dispersion between analysts signals a situation where different models are possible and, therefore, of increased ambiguity. We discuss this issue in more detail in Section 3.2 of the paper.

Using data on U.S. fund flows from the Investment Company Institute, we examine whether ambiguity is *negatively related* to capital flows into equity mutual funds. To ensure that the ambiguity measure we use is not simply capturing risk, we include a measure of market risk in our regressions, calculated as a weighted average of past daily squared excess market returns, as in Anderson et al. (2009). We also control for other factors that have been shown to be important when modelling investors decisions to change their holdings in mutual funds: past fund returns (Ippolito, 1992; Sirri and Tufano, 1998), capital gains (Kamstra et al., 2014), past flows (Ben-Rephael et al., 2011), seasonal effects (Kamstra et al., 2014), advertising expenses (Gallaher et al., 2006), past market returns (Ben-Rephael et al., 2012) and savings (Kamstra et al., 2014). Our results show that controlling for other factors that affect changes in flows, increases in ambiguity are associated with reductions in capital moving into equity mutual funds. This finding confirms the prediction of the theoretical ambiguity literature, that market participation is negatively related to ambiguity in stock returns.

When we dissect equity flows into different equity categories, we find that the effect of ambiguity is more pronounced for funds classed as 'aggressive growth' and 'growth', which tend to invest more heavily in non-dividend paying firms. Such firms, which mainly rely on capital gains to make payoffs to investors, can be thought of as being more ambiguous than dividend-paying firms. This is because dividends are relatively predictable, due to fact that dividend-policy tends to be "sticky" (e.g., Denis and Osobov, 2008). Our findings, therefore, suggest that investors perceive capital gains as more ambiguous, and therefore avoid 'aggressive growth' and 'growth' funds in periods of high ambiguity.

We also analyse the effect of ambiguity on participation in non-equity mutual funds and find some evidence that ambiguity is negatively related to flows and exchanges into government and corporate fixed income funds, and positively related to exchanges into money market funds. This suggests that in periods of high stock market ambiguity, investors avoid both equities and fixed income assets, and seek the safety of a safer and more liquid asset class.

Even though the Anderson et al. (2009) measure corresponds closely to the definitions of ambiguity provided by Ellsberg (1961), there is still a concern that it may be related to market risk or market sentiment. Since these factors can also affect stock market participation decisions, we conduct additional tests to ensure that the negative relationship between ambiguity and participation that we document is not related to sentiment or risk. To account for sentiment, we repeat our baseline analysis by including two additional variables that can capture errors in expectations, namely the sentiment index constructed in Baker and Wurgler (2007), and the median SPF forecast for expected market returns.<sup>4</sup> We find that our results continue to hold in this specification. In terms of risk, we estimate our baseline model using additional risk specifications: realised volatility, forecasts of volatility from GARCH models and the Chicago Board Options Exchange (CBOE) volatility index. Even though the risk variables are generally negative and significant, ambiguity continues to exert a significant negative impact on capital flows into equities in all models, which suggests that it is not simply capturing risk. We discuss our robustness tests in detail in Section 4.5 of the paper.

Ambiguity theories, apart from predicting a negative relationship between ambiguity and capital invested in equities, also predict that the *proportion* of households that participate in equities drops when ambiguity increases. Since fund flows capture this effect only partially,<sup>5</sup> we test this prediction more directly using data from the household of Consumer Finances Surveys, going back to 1990. We use a logistic model, where the dependent variable is a binary indicator of stock market participation. We include various control variables in the model that can affect participation decisions, such as risk attitude, education and income level, along with our ambiguity variable and controls for market risk and market trends. In line with our previous findings, we find that the probability that households invest in equities is significantly reduced when ambiguity is higher, which provides further confirmatory evidence that ambiguity adversely affects stock market participation.

Various behavioural factors have been shown to affect stock market participation, such as social interaction (Hong et al., 2004), cognitive ability (Grinblatt et al., 2012), and trust (Guiso et al., 2008). Ambiguity aversion is another behavioural factor that has been theoretically linked to stock-market participation (Epstein and Schneider, 2010), but, thus far empirical tests of this prediction are mainly based on survey data, with mixed results. In a contemporaneous study Dimmock et al. (2013) elicit ambiguity attitudes using online questionnaires, and find that more ambiguity averse individuals participate less in the stock market. In an earlier survey-based study Guiso et al. (2008) show that ambiguity attitude does not affect stock market participation decisions. Our study complements this work by providing further empirical evidence on the effect of ambiguity on stock market participation, exploiting naturally-occurring financial data.<sup>6</sup>

<sup>4</sup> High values of the Baker and Wurgler sentiment index have been argued to correspond to overly optimistic beliefs (Baker and Wurgler, 2006). In addition, as shown by Hribar and McNinis (2012) and Antoniou et al. (2015), analyst optimism is also an indication of optimistic sentiment.

<sup>5</sup> This is because outflows will reflect both the complete withdrawal of some investors from equity markets, and also the scaling down of existing positions.

<sup>6</sup> For other studies that provide empirical evidence on the effects of ambiguity in the marketplace see Brenner and Izhakian (2011), Antoniou et al. (2014) and Kelsey et al. (2008).

<sup>3</sup> The forecast data is available at <http://www.phil.frb.org/econ/spf/index.html>.

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