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Does volatility matter? Expectations of price return and variability in an asset pricing experiment☆

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ABSTRACT

We present results of an experiment on expectation formation in an asset market. Participants in our experiment must provide forecasts of the stock future return to computerized utility-maximizing investors, and are rewarded according to how well their forecasts perform in the market. In the Baseline treatment participants must forecast the stock return one period ahead; in the volatility treatment, we also elicit subjective confidence intervals of forecasts, which we take as a measure of perceived volatility. The realized asset price is derived from a Walrasian market equilibrium equation with non-linear feedback from individual forecasts. Our experimental markets exhibit high volatility, fat tails and other properties typical of real financial data. Eliciting confidence intervals for predictions has the effect of reducing price fluctuations and increasing subjects' coordination on a common prediction strategy.

1. Introduction

Understanding investors' expectations is crucial to model and predict the behavior of financial markets. Stock exchange professionals try to anticipate modifications in investor sentiment that are likely to impact future price trends, and investors' beliefs are also central to economic theories of asset markets. Various researchers have tried to model investors' expectations by observing data obtained from 'real' markets (e.g., Goetzmann and Massa, 2000; Grinblatt and Keloharju, 2001). However, the main problem with this method of studying beliefs is that expectations in the field are not directly observable, but can only be inferred (with varying degrees of uncertainty) from measurable variables such as price trends and trading volume.

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For this reason, other more direct means of collecting belief data have been attempted: among these are the use of surveys as in Turnovsky (1970), Frankel and Froot (1987), and Shiller (1990), and the design of controlled laboratory experiments. The last method is probably the most accurate to observe the dynamics of expectations, given the total control that the experimenter has over the parameters of the financial 'environment' in which investors operate. While the main focus of early experiments on asset markets was the impact of trading on deviation of prices from an asset fundamental value (with data on beliefs often collected as a "side-product"), more recent experiments focus on expectation formation in isolation from trading, or where no trading takes place (see, e.g., Hommes et al., 2005, 2008; Hey, 1994; Marimon and Sunder, 1993; Sonnemans et al., 2004). In these experiments subjects are usually asked to forecast future prices, either one period ahead, or several periods ahead. In some cases, the time series of prices is exogenously given, while in others it is endogenously generated by the participants' forecasting activity according to an expectations feedback mechanism. In the latter case, the relation between expectations and prices is usually a linear function, which makes both prediction of future prices and coordination of prediction strategies relatively easy.

In our experiment, we create an asset market with positive feedback from individual forecasts. The design is essentially adapted from Hommes et al. (2005): subjects are asked to forecast future returns of an asset, and these forecasts are used by artificial traders to buy or sell (optimal) amounts of the asset in every round. The pricing mechanism is obtained by assuming Constant Absolute Risk Aversion (CARA) behavior on the part of myopic (i.e., acting with one step time horizon) artificial speculators. Unlike previous experiments, we introduce a non-linear, positive feedback mechanism between forecasts and prices. In addition, in one of our treatments, we ask subjects to provide a confidence interval for their prediction, which we take as a measure of the perceived volatility of the corresponding return (and hence of the perceived risk of the investment). We use both forecasted return and forecasted volatility at time $t+1$ (we derive the latter from the confidence interval) to compute the price at time t; therefore subjects' forecasts on returns and confidence intervals have a direct impact on the price level. Forecasted volatility influences the sensitivity of market prices to expectations: a reduction in forecasted volatility increases such sensitivity, while an increase smooths out the relation between expectations and prevailing prices.

As a first step, we intend to investigate whether the presence of a non-linear feedback mechanism between forecasts and prices produces aggregate properties similar to those observed in real financial markets (in terms of, e.g., excess volatility and volatility clustering, fat tails, formation of bubbles and crashes) and a level of coordination in the prediction strategies of participants comparable to that observed in previous experiments that have employed linear expectations feedback functions (Hommes et al., 2005, 2008) We introduce a non-linear feedback system, derived from the utility maximizing behavior of our artificial traders, that more closely resembles the complexity of real financial markets. We then study the resulting aggregate properties of our experimental markets, focusing on both aggregate dynamics and interactions between these and the dynamics of individual expectations.

Secondly, we want to investigate if and how the elicitation of forecasts on volatility, in the form of a confidence interval, has an impact on the dynamics of prices and returns. Despite the obvious importance of perceived volatility (and hence perception of risk) for investment decisions in financial markets, to the best of our knowledge, no experiment so far has tested the role of volatility forecasts, alongside price forecasts, in influencing the dynamics of prices in a financial markets setting.

The remainder of the paper is organized as follows: in Section 2 we review the relevant literature; in Section 3 we describe the asset pricing model together with the experimental design and implementation. Section 4 reports results on aggregate market behavior while Section 5 discusses results on individual behavior. Section 5.2 discusses in detail data on predicted volatility. Finally, Section 6 offers come concluding remarks.

2. Related literature on expectations and volatility in financial markets

Several contributions in economics and finance focus on the effect of behavioral factors on the stock pricing process. After the seminal contribution of Smith et al. (1988), several other studies tried to test the influence of trading on mis-pricing relative to fundamental values, and on the appearance of bubbles and crashes (see, for a review, Sunder, 1995 and Camerer, 1995; Markose et al., 2007 and the entry in the Palgrave Dictionary of Economics by Duffy (2008)). Common to many such experiments is the impossibility to separate the effects of different trading protocols from the effects of participants expectations.[1] Hence, with the purpose of isolating the role of expectations, some experiments elicited predictions of future prices from participants or observers of experimental markets, providing them with monetary incentives for accurate forecasts alone. Some of these experiments are not 'framed' in an asset pricing environment (e.g., Hey, 1994; Marimon and Sunder, 1993; Sonnemans et al., 2004, see also Camerer, 1995 for a review of early experiments on expectation formation). For example, Hey (1994) investigates expectation formation by asking participants to forecast the future values of a variable, knowing its past values, which are generated by a simple first order autoregressive process. The autoregressive process is nonetheless exogenous and consequently there is no expectation feedback in this framework. The authors report a good average forecasting ability. Marimon and Sunder (1993) study pure expectations formation in an experimental version of the model of hyperinflation in Cagan (1994) based on an overlapping generations structure. They estimate simple forecasting rules and observe stable as well as very unstable price dynamics. Sonnemans et al. (2004) use a non linear cobweb model

[1] Many contributions have analyzed the role of different trading protocols over price dynamics, see for example Sunder (1995).