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Estimating the intensity of choice in a dynamic mutual fund allocation decision

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ABSTRACT

The paper analyzes the intensity of choice in an agent based financial optimization problem. Mean-variance optimizing agents choose among mutual funds of similar styles but varying performance. We specify a model for the allocation of new funds, switching between funds, and withdrawals and obtain statistically significant estimates of the intensity of choice parameter. This estimate is also given economic interpretation through the underperformance of funds that use an active style. We find that agents with relative risk aversion of 2 will move 1% of their funds from active to passive for an extra 34 basis points of return.

1. Introduction

Economists continue to explore alternatives to the representative agent paradigm. The interactions of dynamic heterogeneous populations provide explanations for economic behavior that is often difficult to explain using traditional models. The body of literature exploring heterogeneous agents model has grown to be quite extensive. Heterogeneity among agents has been used to model business cycles, financial market phenomena such as bubbles, excess volatility and clustering of returns, currency crises, and the flow of capital into and out of developing countries.

In the agent-based modeling approach, each individual in a population has a simulated interaction in an economic or financial setting. Evolution in strategy is typically governed by an adaptation mechanism such as a genetic algorithm. The approach offers an opportunity to observe the evolution of behavior in response to a changing non-equilibrium environment. The Santa Fe

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artificial stock market of Arthur et al. (1997) and LeBaron et al. (1999) is an example. The computational intensity of agent-based modeling can lead to limits on the size and complexity of the simulated environment. Further, since analysis is typically purely computational, interpreting simulation outcomes can be tricky due to the general lack of a formal model to impose structure.

An alternative strategy has been to sort individual agents into a small number of groups whose behavior is similar. Agents select which group to associate with for the period. Dynamics arise as the population gravitates between groups, typically in response to relative fitness that is itself dependent on the population. The resulting evaluation allows a combination of analytical and computational tools.

Discrete choice dynamics (DCD), introduced by Brock and Hommes (1997), models the evolution in population choice in the adaptive rational equilibrium dynamic (ARED). The framework is now a common tool for modeling the evolutionary process of a dynamic population. The DCD applies most naturally when a large population of individual agents choose among a small number of available discrete options. The heterogeneity of the population manifests as the population distributes among the choice set. The controlling parameter of the DCD model is the 'intensity of choice' (IOC). The parameter determines the strength with which the population responds to perceived superiority of one of the choices. The value of the IOC parameter determines the nature of the population dynamics and thus the evolution of the model as a whole.

The DCD is utilized by Brock and LeBaron (1996) to match the correlation structure of stock return volatility and trading volume. Brock and Hommes (1998) is the first to explore how different values of the IOC parameter impact the dynamics of a financial market. The discrete choice faced by the traders is between alternative types of information to use as input in that period's portfolio decision process. Traders select between a costly rational price predictor and a free linear adaptive belief function (a trend chasing strategy). Increasing the IOC parameter increases the extremes to which the population shifts between the two information sources, causing complex dynamics that range from a stable unique fixed point, bifurcations, and limit cycles, to eventually produce chaotic behavior.

Extensions include Gaunersdorfer (2000) who allows agents to employ risk adjusted performance measures. In de Fontnouvelle (2000), traders are uncertain of the endogenously determined advantage of acquiring private information in a Grossman and Stiglitz (1980) type model. The traders choose between a costly rational forecast or naive adaptive model. Chiarella and He (2002) allows agents to be heterogenous in their tolerance for risk and in their estimates of conditional variance for the different trading strategies. Goldbaum (2003) allows the traders to choose between fundamental analysis and the use of a simple technical trading rule. DeGrauwe and Grimaldi (2006) employ a similar model in a foreign exchange market. Economic applications of the DCD include Chiarella and Khomin (1999) and Brock and de Fontnouvelle (2000). In both, agents select between a small number of methods to forecast inflation.

In all of the considered models, the IOC determines, as in the Brock and Hommes (1998), whether a model possesses a stable fixed point, cycles, or produces chaotic behavior. In application, the IOC parameter is set at the discretion of the modeler. Often it is a control parameter examined over a range of values to explore the dynamic behavior that a particular model is able to achieve.

To date, there have been only a small number of empirical estimates of the IOC. In each case the estimate of the IOC is not the objective, but a component of characterizing market behavior using a dynamic population model. Branch (2004) models inflation forecasts in which agents select between three strategies requiring varying degrees of effort or sophistication. He uses survey data in which households report an estimate of the inflation rate. The researcher does not directly observe which model is being employed by the individual, but the proportion of the market using each option in each period is inferred from the reported forecasts. The value of the IOC is determined by the population's responsiveness to recent performance measures of the prediction strategies. Similarly, Boswijk, Hommes, and Manzan (BHM, 2007) estimate the IOC as part of a model in which traders form predictions using either mean reverting or trend following beliefs for prices. Again, the actual choice by individual traders in the market is unobserved, but population proportions are inferred from the behavior of prices. The data used for the estimation is the same S&P 500 dividend and price