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**Experiments on heterogeneous expectations and switching behavior**

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# Chapter 6

## Summary

Expectation formation plays a central role in dynamic models in modern macroeconomics and finance. This thesis studies expectation formation in dynamic market experiments. One feature that differentiates this thesis from the current mainstream literature is that we apply the heterogeneous expectations framework instead of the traditional representative agent framework assuming that agents have rational expectations. An important aspect of the way we model heterogeneous expectations is that we assume that agents choose from a menu of simple forecasting heuristics, and agents switch between these rules according to some specific fitness measure for the rules. The heuristic that performed better in the past attracts more followers in the future. We study interaction of individual forecasting behavior in different types of expectations feedback systems. We also compare the situation where expectations are directly translated into computed optimal economic decisions and the aggregate market price with the situation where agents solve the optimization problem themselves. Finally, we study switching behavior and apply the switching model to mutual fund choice, where people make dynamic choices between different mutual funds.

Chapter 2 investigates the influence of the type of expectations feedback system on the response of the market price to large unexpected shocks in an experiment where sub-

jects make price forecasts. In this chapter we find that markets with negative expectation feedback (e.g. the traditional cobweb economy) quickly converge to the new fundamental, while markets with positive expectation feedback (e.g. speculative asset markets) do not converge, but show underreaction in the short run, overreaction in the long run and persistent price oscillation and deviation from the rational expectation equilibrium. A simple evolutionary selection model of individual forecasting heuristics based on past fitness measures provides a good description of individual forecasting behavior and the differences in aggregate market outcomes. The evolutionary selection leads to a high fraction of people using adaptive expectations, which stabilizes the market in the negative feedback treatment, and a high fraction of people using a trend following rule, which amplifies the price oscillations in the positive feedback treatment.

Chapter 3 studies whether the speed of convergence to the rational expectation equilibrium (REE) in a negative feedback system depends on whether we use a learning to forecast or a learning to optimize experimental design. Four experimental treatments are designed: (1) subjects form forecasts only, (2) subjects choose quantities only, (3) subjects do both forecasting and quantity decisions, and (4) subjects are paired in teams and one member is assigned the forecasting role while the other is assigned the optimization task. All treatments converge to the REE, but at different speeds. We observe that performance is best in treatment 1 and worst in treatment 3. We find that the low speed of convergence in treatment 3 may be caused by the fact that the subjects in this treatment are cognitively overloaded: given a price forecast, subjects are less likely to make conditionally optimal production decisions in treatment 3 where the forecast is made by themselves, than in treatment 4 where the forecast is made by the other member of their team.

Chapter 4 conducts an experiment where participants make a choice between several

(2, 3 or 4) experimental "funds" in multiple periods. We ask the subjects to make the decision in two blocks of forty periods in order to draw some conclusion on whether experience can enhance the quality of the choice decision. The time series of funds' profits are exogenously generated prior to the experiment and participants are paid for that period according to the profit of the fund they choose. We consider three types of profit time series: (1) a white noise time series where past profits contains no information about future profits, (2) profit time series generated by the Brock-Hommes cobweb model and the Brock-Hommes asset pricing model, which has either a quasi-periodic or a chaotic pattern, and (3) profit time series based on stock indices, which has strong autocorrelation. The data generating process of the profit time series is not revealed to the subjects. The experimental results show that subjects switch a lot between the funds. A discrete choice model with a few lags and a predisposition effect provides a good fit to the data. The intensity of choice parameter in the discrete choice model is higher in the treatments where the profit time series have a strong autocorrelation or quasi periodic pattern. We find no support that experienced subjects make better choices than inexperienced subjects.

Chapter 5 runs a fund choice experiment where the return rates of the funds are independent of past realizations (follow a white noise process), and subjects are informed about this in the instructions. We find that the fund choice decision is still heavily driven by past returns even when this information is irrelevant, and this bias cannot be mitigated with experience and learning. We also add two treatments where subjects choose between a fund with a lower expected return without fee and a fund with a higher expected return but with a fee. Two types of fee structures are considered: one is called front end load, which is a fixed commission charged by the fund when the investor purchases the shares of the fund. The other type is called operation expense or operation fee, which is a management fee paid to the fund usually charged during the period the investor invests in the fund. We find that people choose the fund that charges a fee with higher frequency

when this fee is charged in the form of a front end load fee rather than operation expense (management fee).

A general conclusion from the thesis is that contrary to the traditional view that financial markets have a strong ability to make self-corrections and that the market price converges to its fundamental, speculative asset markets may be destabilizing by themselves due to their intrinsic positive expectation feedback feature. This finding has important policy implications: if financial markets are destabilizing due to the underlying positive feedback feature, regulations and interventions by the government will be helpful in stabilizing the market, especially during times when large shocks take place (e.g. during a financial crisis). The behavior of the subjects in the mutual fund choice experiment shows that mutual fund choice can be driven by irrelevant information on past returns, and this behavioral bias can not be mitigated by learning and experience when we conduct the experiment with business school student subjects with sufficient background knowledge. In industrialized countries such as the US and many European countries, mutual fund choice is a common investment decision for many families, where the decision maker generally has less training in investment and statistics compared to the subjects in our experiment. The mutual fund choice decisions made by these families may be even more biased than those made by the subjects in our experiment. If this is true, it will be very important for the government to take a role in enhancing the transparency of financial markets and promoting the average level of financial literacy in society.