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An empirical examination of heterogeneity and switching in foreign exchange markets[☆]

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ABSTRACT

In order to study the expectation formation of financial institutions in the foreign exchange market we develop and apply a recursive selection and estimation algorithm to a dataset of surveyed foreign exchange market expectations. Responses are classified into two groups and forecasting models are endogenously determined within the groups. Estimation results reveal that a fundamentalist–chartist model is capable of explaining a large portion of foreign exchange market expectations. Fundamentalists are found to have mean-reverting expectations whereas chartists have contrarian expectations. Allowing panelists to switch between models significantly improves the fit of the model, especially at the relatively shorter forecast horizons. We find that the fundamentalist model is increasingly used as the forecast horizon extends. Finally, results indicate that model choice is based on a combination of period-specific and individual-specific determinants.

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1. Introduction

Economics abounds with scenarios in which agents make decisions based on predictions of the future value of endogenously determined variables. This is particularly true in financial markets. It is quite common for competing forecasting models to coexist, each with its own adherents, possibly with shifting popularity over time. The empirical objective of this investigation is to determine whether systematic heterogeneity in forecasts exists consistent with the use of multiple identifiable models, whether market participants do engage in model switching, and what determines the decision to switch to an alternative model. The exercise will be conducted using data on the forecasts of the foreign exchange spot price submitted by financial market institutions active in the markets.

Behavioral finance has documented numerous examples in which psychological factors influence financial decision making; see Barber and Odean (2013) for a recent overview of the literature. A distinction is typically made between biases in preferences (i.e., deviations from the traditional Von Neumann–Morgenstern Expected Utility Theory) and biases in beliefs, or expectations (i.e., deviations from rational expectations). Whereas prospect theory (Kahneman and Tversky, 1979) is

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a proper alternative for modeling preferences, there is no consensus on an alternative for modeling expectations. All we know is that individual expectations deviate from rationality (see, e.g., Cavaglia et al., 1994) and that there are a number of documented biases in expectation formation, such as overconfidence (Huisman et al., 2012) and wishful thinking (Ito, 1990).

Stepping away from the rationality approach introduces a large number of degrees of freedom. A substantial body of literature in economics and finance therefore models investors as heterogeneous and adaptive. The heterogeneity in expectations allows the interaction between traders behaving differently to impact the market. The heterogeneity can exist in a market at equilibrium or may keep the market out of equilibrium. The adaptation allows traders to select behavior appropriate for the perceived, possibly changing, market setting. The sensitivity of the market to the behavior of the traders can produce market destabilizing feedback loops.

Despite wide application, there is surprisingly little micro-level evidence on the empirical validity of adaptive heterogeneity. This paper contributes to the still emerging literature that empirically tests for the presence of adaptive heterogeneity and estimates adaptive heterogeneous agent models. The estimation employs the reported forecasts of financial market institutions on major exchange rates over a variety of horizons and currencies. The analysis seeks evidence of heterogeneity in the models across financial institutions to generate their forecasts at a given point in time. Additionally, the analysis seeks evidence of model switching by individual institutions over time. Procedures are developed to address empirical challenges encountered in the analysis. Finally, we study which type of determinants trigger panelists to switch between models.

Grossman and Stiglitz (1980) establish a theoretical foundation supporting the sustainable co-existence of fundamental and market-based trading strategies. The market-based traders are fully rational and their presence is based on their ability to extract costly information from the price at a cost advantage. A market-based strategy can also survive based on superior performance relative to a fundamental strategy, as in Goldbaum and Panchenko (2010). Dynamics arise as traders switch between trading strategies, as is the case in Brock and Hommes (1997, 1998) where past relative performance determines popularity. The model employs the random element in the discrete choice model of Manski and McFadden (1981) to create heterogeneity in the individual-level choice among the available options. The environment highlights the potentially inherent instability of markets as the minority strategy performs better.

Heterogeneous adaptive agent models provide structure and insight to explanations for market phenomena. Simulations based on such models generate empirical phenomena replicating features of actual market data; examples for the foreign exchange markets are De Grauwe and Grimaldi (2005, 2006), De Grauwe and Markiewicz (2013), and Spronk et al. (2013). Less prevalent in the literature are direct empirical tests of the features that drive the agent-based models.

A number of papers have now sought to estimate adaptive heterogeneous agent models directly, including the Boswijk et al. (2007) determination that trader switching between trend following and mean reverting strategies contributes to swings in the S&P 5000. Lof (2012) extends this study using a multivariate transition function. Evidence of heterogeneity can also be found in the MacDonald and Marsh (1996) survey of market participants documenting the heterogeneity of beliefs and the employment of different models. Branch (2004) finds evidence of adaptive heterogeneous behavior based on survey respondents' reported inflation forecasts. Menkhoff et al. (2009), studying foreign exchange expectations, find substantial heterogeneity which is determined for a large part by the fundamentalist–chartist approach. Reitz et al. (2012) also employ survey expectations and find evidence of behavioral heterogeneity in oil price expectations. Adaptive heterogeneity contributes to the empirical modeling of a number of financial market phenomena. Goldbaum and Mizrach (2008) use a model of adaptive heterogeneity to understand to allocation of new wealth into mutual funds. De Jong et al. (2009) and De Jong et al. (2010) find evidence of behavioral heterogeneity in setting equity prices across multiple markets and in foreign exchange rates respectively. Frijns et al. (2010) find allowing multiple investor strategies simultaneously important for modeling the pricing of options. Markiewicz (2012) use model uncertainty among traders to explain shifts in volatility in foreign exchange markets.

Evidence in favor of switching has also been found at the individual level in experimental settings. Experiments involving market entry decisions often find a wide range of strategies have been employed by the participants that still combined to bring the market to the equilibrium number of entrants. Hommes et al. (2005, 2007) identify four rule-of-thumb strategies employed by participants in a financial market setting rewarding conformity in expectation formation. Bloomfield and Hales (2002) show that even when forecasting a variable known to follow an exogenous random walk, participants switch between the simple rules of trend extrapolation and mean reversion.

A number of issues remains unresolved or are in need of empirical support. The current project also seeks to examine markets for evidence of adaptive heterogeneity and also to determine whether there is evidence in favor of the fundamentalist – chartist dichotomy in foreign exchange markets. As with Branch (2004), the current project seeks to model the reported forecast of survey participants and thus we use a direct measure of individual investor expectations.¹ This is in contrast to efforts to infer expectations from market realizations, such as Frankel and Froot (1990). Two features distinguish the current investigation from that of Branch (2004). First, currency markets offer an environment with strong direct positive feedback between market behavior and participant beliefs. This is especially true given the fact that the survey responses are from the large financial institutions that dominate the foreign exchange market. Second, Branch (2004) estimates the three alternative forecast models on the realized inflation data, imposing the resulting rules on the survey respondents.

¹ Assuming that the survey response is an unbiased proxy for the respondent's expectations.

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