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Characterizing investor expectations for assets with varying risk

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ABSTRACT

How do financial market investors form expectations about assets with different risk characteristics? We examine this question using Euro-area yield curves for AAA-rated and AAA-with-other bonds. Investors' conditional forecasts about the yield curves for different assets, at various forecasting horizons, are modeled using a VAR model with time-varying parameters. Two processes are assumed for the evolution of these parameters: a constant-gain learning model and a new endogenous learning technique proposed here. Both these algorithms allow investors to account for structural changes in the data. The endogenous learning mechanism also allows investors to compensate for large deviations in observed coefficients used for forecasting, relative to past data. Daily data is used to estimate the gain parameters for the learning algorithms, and we find that these gains vary across asset types, implying investors form conditional expectations differently for assets with differential risks. For 2005–2015, the investors' conditional forecasts for the AAA-rated bonds are better described using the endogenous learning mechanism, implying that investors with lower risk preferences are more sensitive to large deviations in the data.

1. Introduction

Expectations of investors about the cross-section of yields are important for policy makers and financial markets: forecasts of the Treasury yield curves are central for the transmission of monetary policy actions from the short end of the yield curve to the long end; conditional expectations about yields on riskier assets affect borrowing costs for a variety of firms and investors. The importance of expectations formation has been widely analyzed. Hommes (2006) presents survey evidence about the rational expectations paradigm may not be fully representative of expectations formation in financial markets: the excess volatility in stock prices and survey expectations of professional forecasters suggest that different forecasting strategies are being used. However, the literature on estimating these expectations from the data is still relatively underdeveloped. Some of the new approaches used to model expectations formation in the boundedly rational approach are discussed in Hommes (2013), such as heterogeneous agent-based models and evolutionary learning.

In this paper, we propose to estimate and characterize the expectations formation process of financial investors. We are specifically interested in exploring how investors form beliefs for asset yields with distinct risk profiles, over different maturities. Traditionally, rational expectations has been the dominant paradigm used for modeling investor beliefs for assets,

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irrespective of their risk characteristics. However, an expanding literature finds that the use of rational expectations may be inadequate. A wide range of survey data from professional forecasters shows systematic variations in forecasting errors[2]; this is counter to the rational expectations hypothesis for such investors. For example, Gourinchas and Tornell (2004) show that the foreign exchange forward premium puzzle can be shown to arise from systematic distortions in investor beliefs about interest rates and document this distortion using survey data from G-7 countries. Bacchetta et al. (2009) investigate the link between predictability of excess returns and expectational errors in the stock market, foreign exchange and bond and money markets, using data on survey expectations of market participants in various countries. The authors find that in markets with predictable excess return patterns, expectational errors of excess returns are also predictable, with same signs and similar magnitudes.

We use a novel European dataset to characterize the conditional expectations of investors. A unique feature of the Euro-area yield curve data is that two types of yield curves are estimated: yields for AAA-rated only bonds, and yields on bonds with AAA- and other types of bonds. This enables us to distinguish between the expectations formation process for bonds with varying risk attributes. We ask whether investors form conditional forecasts of riskless or AAA-rated assets in the same way as for assets with higher risk. Our analysis also examines whether the beliefs of investors are time-varying, over the other characteristics of maturity and forecast horizons.

We employ the following strategy: estimates of the Euro-area yield curves (based on a latent factor model) are obtained from the European Central Bank (ECB). Using this factor model, implied conditional expectations of yields (and associated latent factors) are formed using a vector auto-regressive (VAR) model of the latent factors. We minimize the root mean squared errors (RMSE) of the implied yield forecasts relative to observed yields to reveal which expectation formation process would have achieved the best forecasting performance.

The intuition for our strategy can be described as follows. As a benchmark, consider this framework with constant coefficients. A constant coefficients model restricts the investors to place identical weights on past information while forecasting the short and long asset yields. The model also implies that the investors must be using constant coefficients to form expectations over different forecasting horizons. Thus, it does not allow investors to endogenously adapt to any structural breaks that they might perceive in the evolution of the average yields, or the yield curve slope. This seems undesirable from a practical point of view, particularly during periods of high perceived structural change.

Therefore, we explore alternative specifications for the formation of conditional forecasts of the yield curve factors, and subsequent yields. Theoretical analyses, such as Piazzesi et al. (2015) and Sinha, incorporate adaptive learning into the expectations formation of optimizing agents in models of the yield curve. The implied term structures are more successful at matching the properties of the empirical yield curve, relative to models with time-invariant beliefs. A class of adaptive learning models is also considered here for expectations formation: constant gain learning and an endogenous learning algorithm. The main innovation is that investors are now allowed to vary the weights they place on past information about yields; they are also able to change these weights in response to large and persistent deviations observed in the yield curve factors.

Our empirical strategy allows us to estimate the gain parameters from the data. While these are conditional on the forecasting model used, to our knowledge, these provide the first estimates in the literature about how investors form expectations about different types of assets. We find that over our sample period (between September 2005 and June 2015), the performance of the constant gain algorithm is frequently overtaken by the endogenous learning model for the safest (only AAA-rated) assets. This suggests that investors, in fact, use models with time-varying coefficients to form their conditional forecasts. They also adjust the weights placed on past observations when large deviations in the coefficients are observed. These adjustments in conditional forecasts of yields may also potentially effect the holdings of safe assets by investors.

This paper is organized as follows: Section 2 gives a brief overview of the literature. The factor model for the nominal yield curve is presented in Section 3. Section 4 discusses the different learning mechanisms and Section 5 presents the numerical results. Section 6 concludes.

2. Related literature

Time-varying beliefs have been widely incorporated in partial and general equilibrium models of asset prices to match characteristics of the data. Branch and Evans (2010) use a model of recursive least-squares learning to explain asset pricing dynamics observed in U.S. data, such as excess returns. The authors also show the existence of multiple equilibria, and that under optimal forecasting rules, switching may occur between these equilibria. Laubach et al. (2007) allow investors to re-estimate the parameters of their term structure model based on incoming data. In Branch and Evans (2011), the authors show that when agents learn about the riskiness of stocks, price bubbles and ensuing crashes can be generated. Piazzesi et al. (2015) decompose expected excess returns into the returns implied by the statistical VAR model and survey expectations, used as an approximation for subjective investor expectations. Survey expectations are found to be significantly more volatile compared to model implied returns. The authors use constant-gain learning to describe these expectations, and the excess returns implied by the learning model capture movements in the empirical data better. The common theme of these analyses is the incorporation of subjective beliefs in explaining characteristics of the empirical term structure. The

[2] This is true for forecasts of interest rates as well as macroeconomic variables such as GDP and inflation.

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