Essays in Financial Econometrics Term Structure Modeling and Forecasting

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論 文 内 容 の 要 旨

Pricing assets in the fixed-income market is an important field in financial econometrics. The most basic asset in the fixed-income market is a zero-coupon bond. The complete set of zero-coupon bonds of all maturities results in the term structure of interest rates that forms the basis of the fixed-income market. The term structure of interest rates is also an important element in macroeconomics and finance. At a certain point of time, the yield curve can have different shapes. These shapes, representing a time-varying relationship of the interest rate and maturity, are of great significance for various economic and financial decisions. In this dissertation, we conduct a formal econometric analysis of dynamic term structure models for the Japanese government bond yields. We present some fundamental concepts of government bonds yield to provide a basis for yield curve modeling and forecasting in the first chapter.

Chapter two compares the in-sample fit and out-of-sample forecast accuracy of the Cox-Ingersoll-Ross (CIR) and Nelson-Siegel models. For the in-sample fit, there is a significant lack of information on the short-term CIR model. The CIR model should also be considered too

poor to describe the term structure in the simulation based context. It generates a downward slope average yield curve. Contrary to CIR model, Nelson-Siegel model is not only compatible to fit attractively the yield curve but also accurately forecast the future yield for various maturities. Furthermore, the non-linear version of the Nelson-Siegel model outperforms the linearized one. In the simulation based context, the Nelson-Siegel model is capable to replicate most of the stylized facts of the Japanese market yield curve.

Chapter three empirically examines the role of macroeconomic and stock market variables in the dynamic Nelson-Siegel framework with the purpose of fitting and forecasting the term structure of interest rate. The Nelson-Siegel type models in state-space framework considerably outperform the benchmark simple time series forecast models such as an AR(1) and random walk. The yields-macro model incorporating macroeconomic factors leads to a better in-sample fit of the term structure than the yields-only model. The out-of-sample predictability of the former for the short horizon forecasts is superior to the latter for all maturities, and for the longer horizons the former is still compatible to the latter. Inclusion of macroeconomic factors dramatically reduces the autocorrelation of forecasts errors which has been a common phenomenon of statistical analysis in the previous term structure models.

The monetary policy targets the short rates, however, during the zero interest rate policy (ZIRP) the short end of yield curve will not be any more a policy instrument. Relying on the joint yields-macro latent factors model, chapter four examines the effect of monetary policy stances on term structure and the possible feed-back effect on the real sector using the Japanese experience of ZIRP. The analysis indicates that it is the entire term structure that transmits the policy shocks to the real economy rather than the yields spread only. The monetary policy signals passes through the yield curve level and slope factors to stimulate the economic activity. The curvature factor, besides reflecting the cyclical fluctuations of the economy, acts as a leading indicator for future inflation. In addition, policy influence tends to be low, as the short end becomes segmented toward medium/long-term of the yield curve. Furthermore, volatility in bond markets is found to be asymmetrically affected by positive and negative shocks and the long end tends to be less sensitive to stochastic shocks than the short maturities. The analysis indicates that the traditional expectation hypothesis (with time invariant term premia) does not hold during the ZIRP period.

The results in this dissertation have several implications for policy. The analysis of the dynamic Nelson and Siegel (1987) yield curve model is relevant for how central banks and financial institutions analyze the term structure. If financial institutions and central banks are looking for a model to study the evolution of the yield curve in Japanese market, the Nelson-Siegel family of models could be a good candidate. Furthermore, the models presented in chapter three and four provides a framework to understand important aspects of the recent

intertwined financial crisis, economic recessions and monetary policy regimes. It highlights the importance of yield curve factors for policy analysis that can serve as leading pro-cyclical or counter-cyclical indicators.

論 文 審 査 結 果 の 要 旨

本論文は、日本国債金利の動的な期間構造について詳細な経済分析を行った。国債市場において、最も基本的な債権はゼロ・クーポン債である。本論文はゼロ・クーポン債の市場取引を通して計算された満期別の金利の期間構造を基本データとして、以下の３章からなる分析を行った。

第一章では、国債について基本的な概念を紹介し、イールド・カーブをモデル化し予測を実行するための基本的な数学知識と統計手法を準備した。

第二章では、Cox-Ingersoll-Ross（CIR）モデルとNelson-Siegelモデルの比較を、あてはまりの良さ及び予測力の2つの観点から試みた。その結果、CIRモデルに比べてNelson-Siegelモデルはイールド・カーブに対するあてはまりの良さが上回り、様々な満期の将来利回りの予測精度も良くなることを明らかにした。

第三章では、二章で考察したNelson-Siegelモデルに対し、マクロ経済変数を状態変数に組み込むことで改良を行った。Nelson-Siegelモデルを状態空間モデルに表現し、マクロ経済変数をVARモデルにしたがう状態ベクトルに組み込むことで、カルマンフィルタのアルゴリズムを用いる推定法と予測法を提案した。この改良は従来の予測精度を大きく改善することを明らかにした。

第四章では、三章で用いたマクロ経済変数を組み込んだNelson-Siegelモデルによって、ゼロ金利制約の下での金融政策が国債金利に及ぼす効果を分析した。その結果ゼロ金利制約下では伝統的なexpectation hypothesisが成立しないことを示した。

本論文による金利期間構造の分析は、厳密な数理モデルによる説得的で独創的な分析結果を導いている。以上より、本論文は博士（経済学）として「合格」と判定する。