Yield Curve Modeling And Forecasting The Dynamic Nelson Siegel Approach The Econometric And Tinbergen Institutes Lectures By Francis X Diebold 2013 01 15

The evolution of the yields of different maturities is related and can be described by a reduced number of commom latent factors. Multifactor interest rate models of the finance literature, common factor models of the time series literature and others use this property. Each model has advantages and disadvantages, and it is an empirical matter to evaluate the performance of the approaches. This exercise compares 4 alternative models for the term structure using 3 different markets: the Brazilian domestic and sovereign market and the US market.

This Element is intended for students and practitioners as a gentle and intuitive introduction to the field of discrete-time yield curve modelling. I strive to be as comprehensive as possible, while still adhering to the overall premise of putting a strong focus on practical applications. In addition to a thorough description of the Nelson-Siegel family of model, the Element contains a section on the intuitive relationship between P and Q measures, one on how the structure of a Nelson-Siegel model can be retained in the arbitrage-free framework, and a dedicated section that provides a detailed explanation for the Joslin, Singleton, and Zhu (2011) model.

Affine term structure models (ATSMs) are one set of popular models for yield curve modeling. Given that the models forecast yields based on the speed of mean reversion, under what circumstances can we distinguish one ATSM from another? The objective of my dissertation is to quantify the benefit of

knowing the “true” model as well as the cost of being wrong when choosing between ATSMs. In particular, I detail the power of out-of-sample forecasts to statistically distinguish one ATSM from another given that we only know the data are generated from an ATSM and are observed without errors. My study analyzes the power and size of affine term structure models (ATSMs) by evaluating their relative out-of-sample performance. Essay one focuses on the study of the one-factor ATSMs. I find that the model’s predictive ability is closely related to the bias of mean reversion estimates no matter what the true model is. The smaller the bias of the estimate of the mean reversion speed, the better the out-of-sample forecasts. In addition, my finding shows that the models' forecasting accuracy can be improved, in contrast, the power to distinguish between. different ATSMs will be reduced if the data are simulated from a high mean reversion process with a large sample size and with a high sampling frequency. In the second essay, I extend the question of interest to the multi-factor ATSMs. My finding shows that adding more factors in the ATSMs does not improve models' predictive ability. But it increases the models' power to distinguish between each other. The multi-factor ATSMs with larger sample size and longer time span will have more predictive ability and stronger power to differentiate between models.

This thesis examines the macro-finance-fiscal term structure model to incorporate fiscal instability variables and the term spread to understand the impact of the sovereign debt crisis on the evolution of the yield curve. My findings reveal financial instability increases the term spread associated with the expectation of higher sovereign default risk and consequently signals economic agents to reduce their spending, and thus worsens economic activity. Secondly, I also investigate whether the dynamic factor model with nonparametric factor loadings is more accurate relative to other term structure models by employing the dynamic semi-parametric factor model (DSFM). The empirical results indicate that a

better in-sample fit is provided by the dynamic semiparametric factor model. However, the overall forecasting results are not encouraging. The dynamic semiparametric factor model provides accurate results in forecasting a persistent trend while the dynamic Nelson-Siegel model is more suitable to fit more volatile series. Thirdly,I use a Sheen-Trueck-Wang business conditions index for term structure modeling and forecasting. I find the cross-sectional yield provides guidance to anchor the yield in the next period. The prediction performance of the model is enhancedby using the index since it includes information on frequently released or more recent available data. The index is significantly related to the slope factor, which suggests the forward-looking information from the index inuences the adjustmentthe in the yield slope. Lastly, I examine the effectiveness of the US quantitative easing (QE) policy with a Bayesian structural vector auto regressive (B-SVAR)model with sign restrictions. I find the transmission mechanism of the Federal Reserve asset purchase effectively expands output and avert deflation through a compression in the yield spread.

This book will give the reader insight into how to model yield curves in our incomplete and imperfect financial markets. An extensive list of yield curve models are shown and discussed. Using actual market instruments, these models are then applied and the different yield curves are compared. It is assumed that the reader has a basic understanding of the financial instruments available in the market. Various issues that have to be taken into account in practice are discussed, like daycount conventions, business-day rules, the credit quality of the instrument and liquidity to name but a few. It is also shown how yield curves can be used to estimate credit spreads and country risk premiums. Creating a yield curve model has some implications in risk management. Specifically - the model, operational, liquidity and basis risks are discussed.

Two Essays on Estimation and Inference of Affine Term Structure Models

The Forecasting Power of the Yield Curve, a Supervised Factor Model Approach
Modeling and Forecasting Canadian Yield Curve with Macroeconomic Determinants
A Comparative Study
Forecasting of Macro Aggregates Using Yield Curve Information
The Dynamic Nelson-Siegel Model Applied to Swiss Market Data
A Practical Guide to Implementing, Monitoring and Understanding Fixed-Income Portfolios
Term Structure Modeling, Forecasting and Implications for Monetary Policy
Models and Forecasting
Forecasting the Yield Curve in a Data-rich Environment Using the Factor-augmented Nelson-Siegel Model

It is widely acknowledged that many financial modelling techniques failed during the financial crisis, and in our post-crisis environment many techniques are being reconsidered. This single volume provides a guide to lessons learned for practitioners and a reference for academics. Including reviews of traditional approaches, real examples, and case studies, contributors consider portfolio theory; methods for valuing equities and equity derivatives, interest rate derivatives, and hybrid products; and techniques for calculating risks and implementing investment strategies. Describing new approaches without losing sight of their classical antecedents, this

collection of original articles presents a timely perspective on our post-crisis paradigm. Highlights pre-crisis best classical practices, identifies post-crisis key issues, and examines emerging approaches to solving those issues Singles out key factors one must consider when valuing or calculating risks in the post-crisis environment Presents material in a homogenous, practical, clear, and not overly technical manner

Since arbitrage-free is a desirable theoretical feature in a healthy financial market, many efforts have been made to construct arbitrage-free models for yield curves. However, little attention is paid to review if such restriction will improve yield forecast. We evaluate the importance of arbitrage-free restriction on dynamic Nelson-Siegel term structure when forecasting yield curves. We find that it doesn't help. We also compare these two Nelson-Siegel dynamic models with a benchmark dynamic model and show that Nelson-Siegel structure improve forecasts for long-maturity yields.

Term structure of interest rates is crucial for pricing bonds and managing financial risks. The yield curve of zero-coupon bonds can typically be used to measure the term structure of

interest rates. In this paper, we use the popular Nelson-Siegel three-factor framework to model the entire Canadian yield curve. The empirical results show that the model fits the Canadian yield curve well. We estimate vector autoregressive models for the three factors in order to produce out-of-sample forecasts, and also employ seven natural competitors for comparison. Our forecast results are encouraging. Our model is superior to most competitors, especially at longer horizons. We further incorporate macro variables into the yield-only model. From the results of forecast comparison test between the yield-only model and yield-macro model, we conclude that a joint dynamic term structure model incorporating macro variables contributes to sharpening our ability of forecasting yields accurately out of sample.

This volume explores dynamic factor model specification, asymptotic and finite-sample behavior of parameter estimators, identification, frequentist and Bayesian estimation of the corresponding state space models, and applications.

Despite powerful advances in yield curve modeling in the last twenty years, comparatively little attention has been paid to

the key practical problem of forecasting the yield curve. In this paper we do so. We use neither the no-arbitrage approach, which focuses on accurately fitting the cross section of interest rates at any given time but neglects time-series dynamics, nor the equilibrium approach, which focuses on time-series dynamics (primarily those of the instantaneous rate) but pays comparatively little attention to fitting the entire cross section at any given time and has been shown to forecast poorly. Instead, we use variations on the Nelson-Siegel exponential components framework to model the entire yield curve, period-by-period, as a three dimensional parameter evolving dynamically. We show that the three time-varying parameters may be interpreted as factors corresponding to level, slope and curvature, and that they may be estimated with high efficiency. We propose and estimate autoregressive models for the factors, and we show that our models are consistent with a variety of stylized facts regarding the yield curve. We use our models to produce term-structure forecasts at both short and long horizons encouraging results. In particular, our forecasts appear much more accurate at long horizons than various standard benchmark

forecasts.

Essays on the Government Bond Yield Curve

Modeling and Forecasting Electricity Loads and Prices

The Dynamic Nelson-Siegel Approach

A Practitioner's Guide to Discrete-Time Yield Curve Modelling

Comparing models for forecasting the yield curve

Yield Curve Modeling

Yield-curve Based Probit Models for Forecasting US Recession

High Dimensional Yield Curves

Yield Curve Dynamics

Modeling and Forecasting the Co-movement of International Yield Curve Drivers

Focusing on Switzerland and the Swiss fixed income market, this paper discusses yield curve fitting and forecasting both on a theoretical and practical level. In the first part of this work, we theoretically introduce the topics of fixed income valuation, spot rates and yield curves. Subsequently, we model interest rates offered on Swiss governmental bonds over 1988-2015 through the Dynamic Nelson-Siegel (DNS) model while assessing both its in-sample and out-of-sample performance. We firstly argue that the DNS offers rock-solid in-sample fitting capabilities. After having forecasted Swiss spot rates over 2014-2015, we conclude that the DNS provides satisfying forecasting results although it is unable to capture sudden and dramatic movements in real data such as the removal of the 1.20 Euro/CHF minimum

exchange rate in January 2015. Finally, we provide suggestions, namely some further adjustments which might help in obtaining more precise results in the future.

This book offers an in-depth and up-to-date review of different statistical tools that can be used to analyze and forecast the dynamics of two crucial for every energy company processes—electricity prices and loads. It provides coverage of seasonal decomposition, mean reversion, heavy-tailed distributions, exponential smoothing, spike preprocessing, autoregressive time series including models with exogenous variables and heteroskedastic (GARCH) components, regime-switching models, interval forecasts, jump-diffusion models, derivatives pricing and the market price of risk. Modeling and Forecasting Electricity Loads and Prices is packaged with a CD containing both the data and detailed examples of implementation of different techniques in Matlab, with additional examples in SAS. A reader can retrace all the intermediate steps of a practical implementation of a model and test his understanding of the method and correctness of the computer code using the same input data. The book will be of particular interest to the quants employed by the utilities, independent power generators and marketers, energy trading desks of the hedge funds and financial institutions, and the executives attending courses designed to help them to brush up on their technical skills. The text will be also of use to graduate students in electrical engineering, econometrics and finance wanting to get a grip on advanced statistical tools applied in this hot area. In fact, there are sixteen Case Studies in the book making it a self-contained tutorial to electricity load and price modeling and forecasting.

Rebonato provides an authoritative, clear, and up-to-date explanation of the cutting-edge innovations in affine modeling for government bonds, and provides readers with the precise

tools to develop their own models. This book combines precise theory with up-to-date empirical evidence to build, with the minimum mathematical sophistication required for the task, a critical understanding of what drives the government bond market.

We test and estimate a variety of alternative models of the yield curve, using weekly, high-quality U.K. data. We extend the Campbell-Shiller technique to the overlapping data case and apply it to reject the pure expectations hypothesis under rational expectations. We also find that risk measures, in the form of conditional interest rate volatility, are unable to explain the term premium. A simple, market segmentation approach is, however, moderately successful in explaining the term premium.

This paper obtains the forecasts of Colombian macroeconomic variables and the yield curve by jointly modeling their dynamics. For this purpose, I use unrestricted Bayesian Vector Auto Regressive (VAR) models and the no-arbitrage state-space representation developed by Ang and Piazzesi [2003]. Both the Bayesian VAR and the no-arbitrage representations are used to estimate closed economy, small open economy ancl macro-latent factor models. The parameters of the models are estimated with Bayesian techniques for different horizons using the predictive likelihood function. Monthly data between 2006-2012 of the inflation, the overnight-interbank interest rate, an economic activity indicator, the 10-year treasury rate and the 5-year CDS was used The main finding is that the out-of-sample forecasts of the interbank overnight interest rate and the inflation consistently improve when the yield curve is incorporated. Moreover, the models thnt irnpose the no-arbitrage restriction consistently out-perform the unrestrict.ed VARs. On the Other hant, the model wit,h the best. performance in terms of both the RMSE and the standard deviation of the forecasts incorporates closed-

economy variables and the short-term yield. Adding longer-term yields and small open economy variables does not appear to improve further the forecasts.

Anchoring the Yield Curve Using Survey Expectations

Modelling and Forecasting the Yield Curve Under Model Uncertainty

Robustness in Econometrics

Stripping, Factor Decompositions, Business Cycles and Forecasting

Yield Curve Modeling and Forecasting Using Semiparametric Factor Dynamics

Neural Advances in Processing Nonlinear Dynamic Signals

State-of-the-art Techniques for Modeling, Trading and Hedging

A Structural Approach

A Statistical Approach

Modelling and forecasting stock return volatility and the term structure of interest rates

The goal of this thesis is to forecast the US Treasury yield curve. In order to do so, the yield curve will first be modeled by the Nelson-Siegel (1987) method with the Diebold and Li (2006) extension and then forecasted. The data used is provided by Gürkaynak, Sack, and Wright (2006). The large dataset consists of fitted yields of US Treasury bonds. The conclusion of this thesis is that there is evidence that the Diebold and Li (2006) method can be applied to the dataset used. The forecasting results show mostly the correct change in direction of the yield curve but lack accuracy. The forecasting ability is quite well considering that the model does not include any macro-economic factors which are proven to influence the

yield curve largely according to the results by Diebold, Piazzesi, and Rudebusch (2005).

In my dissertation, I study relationships between macroeconomics and financial markets. In particular, I empirically investigate the links between key macroeconomic indicators, such as output, inflation, and the business cycle, and the pricing of financial assets. The dissertation comprises three essays. The first essay investigates how the entire term structure of interest rates is influenced by regime-shifts in monetary policy. To do so, we develop and estimate an arbitrage-free dynamic term-structure model which accounts for regime shifts in monetary policy, volatility, and the price of risk. Our results for U.S. data from 1985-2008 indicate that (i) the Fed's reaction to inflation has changed over time, switching between "more active" and "less active" monetary policy regimes, (ii) the yield curve in the "more active" regime was considerably more volatile than in the "less active" regime, and (iii) on average, the slope of the yield curve in the "more active" regime was steeper than in the "less active" regime. The steeper yield curve in the "more active" regime reflects higher term premia that result from the risk associated with a more volatile future short-term rate given a more sensitive response to inflation. The second essay examines the predictive power of the entire yield curve for aggregate output. Many studies find that yields for government bonds predict real economic activity. Most of these

studies use the yield spread, defined as the difference between two yields of specific maturities, to predict output. In this paper, I propose a different approach that makes use of information contained in the entire term structure of U.S. Treasury yields to predict U.S. real GDP growth. My proposed dynamic yield curve model produces better out-of-sample forecasts of real GDP than those produced by the traditional yield spread model. The main source of this improvement is in the dynamic approach to constructing forecasts versus the direct forecasting approach used in the traditional yield spread model. Although the predictive power of yield curve for output is concentrated in the yield spread, there is also a gain from using information in the curvature factor for the real GDP growth prediction. The third essay investigates time variation in CAPM betas for book-to-market and momentum portfolios across stock market volatility regimes. For our analysis, we jointly model market and portfolio returns using a two-state Markov-switching process, with beta and the market risk premium allowed to vary between "low" and "high" volatility regimes. Our empirical findings suggest strong time variation in betas across volatility regimes in most of the cases for which the unconditional CAPM can be rejected. Although the regime-switching conditional CAPM can still be rejected in many cases, the time-varying betas help explain portfolio returns much better than the unconditional CAPM, especially when market volatility is high.

This book proposes neural networks algorithms and advanced machine learning techniques for processing nonlinear dynamic signals such as audio, speech, financial signals, feedback loops, waveform generation, filtering, equalization, signals from arrays of sensors, and perturbations in the automatic control of industrial production processes. It also discusses the drastic changes in financial, economic, and work processes that are currently being experienced by the computational and engineering sciences community. Addresses key aspects, such as the integration of neural algorithms and procedures for the recognition, the analysis and detection of dynamic complex structures and the implementation of systems for discovering patterns in data, the book highlights the commonalities between computational intelligence (CI) and information and communications technologies (ICT) to promote transversal skills and sophisticated processing techniques. This book is a valuable resource for a. The academic research community b. The ICT market c. PhD students and early stage researchers d. Companies, research institutes e. Representatives from industry and standardization bodies

ABSTRACT: In practice, economist do not observe the discount function, spot or forward curves so we must extract them from a few observed points along the yield curve. To do this I introduce a new method called the Global Piecewise Quartic Polynomial Interpolation to construct

maximally smooth forward curves with zero pricing errors for government coupon bonds. This method can construct any spot and forward curve shape with zero pricing errors, including upward sloping, downward sloping, inverted or humped. Next, I use three methods to decompose the constructed forward and the implied spot curves into factors and loadings: (i) the DL three-factor model, (ii) principal components and (iii) Chebyshev polynomial approximations. My analysis shows that the first three loadings for the spot curve and the first, the second and the fourth loadings in the forward curve can be interpreted as level, slope and curvature, respectively. Moreover, the methods show that five, or two additional, factors are needed to model the forward curve with the same precision as can be achieved with three factors for the spot curve. Simple and multiple correlations are used to analyze the relationships between the business cycle and the five factors that are needed to model the forward curve, the three factors needed to model the spot curve and the three factors of the [4] model. The results suggest that the additional factors required to model the forward curve are indeed related to the business cycle. The third factor on the principal components on the forward is a leading indicator for the trough and the fifth factor on the principal components on the forward is a leading indicator for the peak. Finally, ARIMA models are used to estimate and forecast the spot and forward curve factors. I find that forward curve factors produce more

accurate forecasts than the three [4] factors.

This book presents recent research on robustness in econometrics. Robust data processing techniques – i.e., techniques that yield results minimally affected by outliers – and their applications to real-life economic and financial situations are the main focus of this book. The book also discusses applications of more traditional statistical techniques to econometric problems. Econometrics is a branch of economics that uses mathematical (especially statistical) methods to analyze economic systems, to forecast economic and financial dynamics, and to develop strategies for achieving desirable economic performance. In day-by-day data, we often encounter outliers that do not reflect the long-term economic trends, e.g., unexpected and abrupt fluctuations. As such, it is important to develop robust data processing techniques that can accommodate these fluctuations.

Stability and Dynamics

Bond Pricing and Yield Curve Modeling

Modeling Interest Rate Dynamics

Essays on Macro-finance Relationships

Modelling the Yield Curve

The forecasting power of internal yield curve linkages

With Empirical Illustrations and MATLAB Examples

Forecasting the Yield Curve

Forecasting the Yield Curve of Government Bonds

Lessons Learned from the Crisis and Future Challenges

Understanding the dynamic evolution of the yield curve is critical to many financial tasks, including pricing financial assets and their derivatives, managing financial risk, allocating portfolios, structuring fiscal debt, conducting monetary policy, and valuing capital goods. Unfortunately, most yield curve models tend to be theoretically rigorous but empirically disappointing, or empirically successful but theoretically lacking. In this book, Francis Diebold and Glenn Rudebusch propose two extensions of the classic yield curve model of Nelson and Siegel that are both theoretically rigorous and empirically successful. The first extension is the dynamic Nelson-Siegel model (DNS), while the second takes this dynamic version and makes it arbitrage-free (AFNS). Diebold and Rudebusch show how these two models are just slightly different implementations of a single unified approach to dynamic yield curve modeling and forecasting. They emphasize both descriptive and efficient-markets aspects, they pay special attention to the links between the yield curve and macroeconomic fundamentals,

and they show why DNS and AFNS are likely to remain of lasting appeal even as alternative arbitrage-free models are developed. Based on the Econometric and Tinbergen Institutes Lectures, Yield Curve Modeling and Forecasting contains essential tools with enhanced utility for academics, central banks, governments, and industry.

The dynamic behavior of the term structure of interest rates is difficult to replicate with models, and even models with a proven track record of empirical performance have underperformed since the early 2000s. On the other hand, survey expectations are accurate predictors of yields, but only for very short maturities. We argue that this is partly due to the ability of survey participants to incorporate information about the current state of the economy as well as forward-looking information such as that contained in monetary policy announcements. We show how the informational advantage of survey expectations about short yields can be exploited to improve the accuracy of yield curve forecasts given by a base model. We do so by employing a flexible projection method that anchors the model forecasts to the survey expectations in segments of the yield curve where the

informational advantage exists and transmits the superior forecasting ability to all remaining yields. The method implicitly incorporates into yield curve forecasts any information that survey participants have access to, without the need to explicitly model it. We document that anchoring delivers large and significant gains in forecast accuracy for the whole yield curve, with improvements of up to 52% over the years 2000-2012 relative to the class of models that are widely adopted by financial and policy institutions for forecasting the term structure of interest rates.

• Invaluable to financial professionals • Breakthrough that examines both theory and practical solutions Examines both the advanced theory and practice of these techniques. Topics include: single- and multi-factor models; applying yield-curve modeling to risk management; forecasting short-term interest rates; unique yield-curve volatility; and trading strategies. The book offers a detailed, robust, and consistent framework for the joint consideration of portfolio exposure, risk, and performance across a wide range of underlying fixed-income instruments and risk factors. Through extensive use of practical

examples, the author also highlights the necessary technical tools and the common pitfalls that arise when working in this area. Finally, the book discusses tools for testing the reasonableness of the key analytics to help build and maintain confidence for using these techniques in day-to-day decision making. This will be of keen interest to risk managers, analysts and asset managers responsible for fixed-income portfolios.

Comparing Models for Forecasting the Yield Curve
Yield-curve Based Probit Models for Forecasting U.S. Recessions
Dynamic Factor Models
Yield Curve Modeling and Forecasting
Fixed-Income Portfolio Analytics
Rethinking Valuation and Pricing Models
Forecasting the Yield Curve Using Priors from No Arbitrage Affine Term Structure Models
Forecasting the Term Structure of Government Bond Yields
Dynamic Modeling Approach to Forecast the Term Structure of Government Bond Yields