

***Estimating and Interpreting the YIELD CURVE*, Nicola Anderson, Francis Breedon, Mark Deacon, Andrew Derry and Gareth Murphy (Series in Financial Economics and Quantitative Analysis) John Wiley and Sons, Chichester, England, 1996, pp. XIII + 221.**

For credible monetary policy, central banks generally place emphasis on a wide range of economic indicators. In this context information derived from asset prices on market expectations of future inflation and interest rates have assumed critical significance with the elevation of market expectations to the status of primary indicator for liquidity management. Following sterling's dramatic exit from the European Exchange Rate Mechanism in September 1992, the Bank of England reviewed its underlying analytical framework for monetary management. One of the crucial aspects that has received pointed attention in this context is the analysis and modeling of the term structure of interest rates and comparisons of nominal and index-linked government debt prices that can be used to extract information on market expectations of future movements in inflation. The Bank of England used to estimate yield curves to price new issues of government debt and to value loans to public corporations and local authorities which is now the general practice of many pro-market oriented Central Banks. But the shift of policy focus to a multi-indicator approach, anchoring mainly on information based on asset prices, has led the Bank to explore the best possible way of estimating and analysing the term structure of interest rate. The Bank has undertaken a review of theoretical and empirical literature on the term structure of interest rates. With this objective in view, the book has been brought out authored by five of the then members of the Bank's Quantitative Financial Economics group. The book provides a competent account of what could interest the policy makers, practitioners and academicians alike in issues relating to term structure of interest rates. In fact, in the authors' own admission the book could be an unique contribution, since there is no single publication which successfully combines theoretical techniques and empirical issues in pricing securities

whilst never losing sight of their use in the 'real-world' applications.

The book is primarily concerned with the relationship between market interest rates and the valuation of debt instruments. Different forms of debt are distinguished primarily by the creditworthiness of the borrower. The governments are deemed to be the borrowers least likely to default on their debt repayments, implying that the cost of borrowing funds in the country will never be lower than that faced by the government. For this reason, the interest rates charged to government are of particular importance for the market related yield curve.

The volume under review could either be read from cover to cover, or used for reference on chapter by chapter basis. It has nine chapters blending relevant theory and empirical analysis in an exemplary way. Chapter 1 (The term structure of interest rates) presents the basic tools required for the economic analysis of bond markets. It introduces the term structure of interest rates and places its important role in the valuation of debt instruments. Bond arithmetic techniques cover the bond price equation, accrued interest and continuous compounding, measuring the return on a bond, interest rate risk and immunization, convexity of price-yield function, the implied forward rate curve, spot (or Zero coupon) yield curve, par yield curve, forward yield curves, etc. This chapter suggests that the expectations theory of the yield curve, i.e., implied forward interest rate representing the market expectations of future short-term rates is of fundamental importance to both market practitioners and to the authorities monitoring market interest rates. The intuition behind this theory is that, in a deterministic world, expected rates of return on different investment strategies are equalized only when all forward rates equal expected short-term interest rates. The pure expectations theory states that the observed market forward curve provides the best forecast of future interest rates.

In Chapter 2 the book discusses two distinct approaches to modeling the term structure of interest rates; first, measuring the

term structure using statistical techniques and second, using asset pricing models based on equilibrium or arbitrage arguments. This chapter briefly introduces some of the problems associated with the best known approaches to yield curve estimation and argues that the choice of a particular model depends on the purpose to which it is to be put. For example, for macro economic analysis while a parsimonious model may be the preferred option, a highly flexible non-parametric approach may have greater appeal for pricing. What is outstanding in the book is its rigorous presentation of various models, giving a critical assessment of the econometric techniques used for estimating discount functions. For the readers who are interested in mathematical proofs of the models, the appendices to this chapter provide step-wise solution of some of the more complicated discount functions with proper referencing. This can be viewed as the core chapter of the book as it develops the theoretical foundations that underlay the term structure models.

Chapter 3 (comparing yield curve models) provides a study of comparative approach to evaluating the performance of alternative estimation methods measuring the term structure of interest rates, both in theory and in practice. The authors note that there is a trade-off between smoothness and the goodness of fit of yield curve estimates because of idiosyncrasies influencing the market price of a bond. Taxation rules, the existence of derivative markets, the classification of certain bonds as 'benchmarks', ex-dividend effects etc. might influence the market behaviour. These factors also need to be taken into account when choosing a method of estimating yield curve for a particular market.

Discussing the arbitrage opportunities in the market, the book shows that normally security-pricing proceeds with the assumption of 'no-arbitrage equilibrium'. Arbitrage arises in the case of mispricing which allows an investor to make a riskless profit. The relationship between no-arbitrage and risk-neutral pricing is discussed in Chapter 4 (Equilibrium term structure models). Some examples of equilibrium models, in which the market prices of risk are explicitly incorporated into the model are presented in this chapter. The role of no-arbitrage equilibrium was seen to be central

to the development of term structure models. It establishes the validity of risk-neutral pricing methods which often leads to particularly tractable methods of pricing interest rate contingent claims.

The pure models of term structure of interest rates ignore several real world complications involving the pricing of bonds. As the authors allude to in this book had bond price been only determined by the term structure, it would have been possible to determine exactly the price of every bond in the market. Bond markets are, however, driven by a number of other factors which influence their relative valuation. The most important of these factors is the tax regime. Different tax regimes have different impacts on bond prices. Different investors may value the same bond differentially because investor specific tax rules provide different cashflows net of tax. There could also be bond-specific tax rules, which differentiate between the yields from two bonds although they may have similar gross cashflows. The authors pose an interesting question as to whether tax effects can be treated as 'noise' in the bond pricing models. Such a course could assume that the 'noises' are evenly distributed, which of course is not a reasonable assumption to make. Tax regulations do affect pricing and a statistically fitted curve with the assumption of symmetrical distribution of noise can introduce bias to the estimated term structure. The authors in chapter 5 review various models that take explicit recognition of tax regimes and make comparisons to show the best preferred model.

Chapter 6 introduces bonds with embedded options to show why such instruments cannot readily be thought of in the same way as conventional bonds for valuation and estimation of yield curve. This chapter provides a description of the techniques for valuing such bonds using the appropriate theoretical framework. In their simplest form bonds with embedded options have two distinct components - a straight bond component and an option component. Hence different perceptions regarding yields and interest rate volatility can be consistent with the same price. These bonds are very common among corporate debt issues as they provide the advantage of trading yield levels against views on volatility. The authors discuss two most common embedded options viz., callable and con-

vertible bonds and go into pricing issues with considerable depth. The book provides an authoritative account of the index-linked bonds, given the Bank of England's pioneering position in this regard. Using index-linked bond prices, it is possible to estimate the term structure of real interest rates. The estimation of such a curve provides the 'real' counterpart to the nominal curves. In particular, it enables the derivation of a real forward rate curve. In practice, however, there are two factors which complicate such estimation: there is the lag in indexation and, in most markets, there are typically far fewer indexed linked bonds than conventional ones. Chapter 7 (Index-linked debt) presents a very useful discussion on the concept and related issues regarding index-linked or indexed bonds. The authors provide perhaps the most articulated and competent account of how index-linked bonds work in practice in several countries and how such bonds are useful in extracting information about the market's expected inflation.

The book devotes a full chapter (Chapter 8) to the expectation hypothesis and its role in setting term premia in the market. The expectations hypothesis is based on the general proposition that expectations about future interest rates affect the current level of long rates. Theoretical aspects regarding the expectations hypothesis (the unbiased expectations hypothesis, the local expectations hypothesis, and the return to maturity hypothesis) are discussed. This chapter gives a detailed theoretical account of expectations hypothesis and practical issues in modeling yield curve using the theory as basis. An interesting aspect of this chapter is that it provides the reader with a detailed technical knowledge of how to develop the expectation theory into an estimable specification for conducting empirical analysis.

In the last chapter the authors turn to the empirical evidences on the success or otherwise of market expectations as predictors of future economic variables. In practice, this means testing whether term premia are constant or time variant. As the authors own account reveal, "the evidence produces the surprising conclusion that for most countries the expectation theory with a constant term premium cannot be rejected". This is a significant conclusion as far

as its policy implications are concerned, since this not only validates the simple yield curve models but also makes a strong case for basing policies on market expectations as mirrored in bond prices. The authors note that the only exception to a stable term premia is the US bond market, which makes the interpretation of yield curve difficult in that country. While the yield curve seems to be over-reacting to future short rates in the US, providing the basis for easy rule to market participants to make excess profits, in the authors' view "it is possible that these excess profits are simply fair compensation for risk. Such easy trading rules, however, do not appear to exist in other markets".

Whilst any views expressed in this book are those of the authors and not necessarily those of the Bank of England, it is to be recognised that the Bank of England has done a commendable service by supporting and encouraging the publication of this book. It remains probably the most useful source on its subject, and that is a great deal to be thankful for. Given the exhaustive set of issues discussed with incisive analysis and terse presentations, the book is an extremely valuable contribution to the literature on interest rate. This makes the book a worthy piece for possession.

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