Available online at www.sciencedirect.com
SCIENCE DIRECT®
ELSEVIER
International Review of Financial Analysis 14 (2005) 428–438
IRFA
INTERNATIONAL REVIEW OF
Financial Analysis

Derivative prices from interest rate models: results for Canada, Hong Kong, and United States

K. Ben Nowman[a,*], Ghulam Sorwar[b]

[a]*Department of Finance and Business Law, Westminster Business School, University of Westminster, 35 Maryleborne Road, London NW1 5LS, United Kingdom*
[b]*Cardiff Business School, Aberconway Building, Column Drive, Cardiff, CF1 3EU, UK*

Accepted 22 October 2004
Available online 19 November 2004

Abstract

In this paper, we compute implied bond and contingent claim prices from the CKLS, Vasicek, CIR, and BS interest rate models using historical estimates for Canada, Hong Kong, and the United States. We find that default-free bond prices and contingent claim prices are sensitive to the assumed model used for these currencies, and that for Canada the CIR is the best, for Hong Kong the Vasicek and CIR models, and for the US the BS model.

JEL classification: G13; C19
Keywords: CKLS; Bonds; Prices; Call; Puts

1. Introduction

In an important paper in interest rate modelling, Chan, Karolyi, Longstaff, and Sanders (CKLS, 1992) developed a general short-term interest rate model which included many well-known models used in the literature as special cases (e.g., Brennan & Schwartz, 1980 (BS); Cox, Ingersoll, & Ross, 1985 (CIR); Vasicek, 1977). They found for the United States that

* Corresponding author.
E-mail address: ben_nowman@hotmail.com (K.B. Nowman).

1057-5219/$ - see front matter © 2004 Elsevier Inc. All rights reserved.
doi:10.1016/j.irfa.2004.10.010

the relationship between the volatility of rates and the level of rates was much higher then assumed in the above models. In addition, CKLS provided a comparison of prices of bond options implied by the historically estimated CKLS specification and some special cases on U.S. data and found significant variations in the call option values. In Nowman (1997), using Gaussian estimation methods of Bergstrom (1983) and an alternative discrete model for estimation, it was shown that the volatility of rates is not highly dependent on the level of rates in the UK compared to the results of CKLS.

More recently, Nowman and Sorwar (1999) estimated the CKLS model using Nowman (1997) on monthly Euro-currency rates for Australia, Japan, and the UK. Using these estimates, Nowman and Sorwar computed implied prices using the recently developed Box Method by Barone-Adesi, Allegretto, Dinenis, and Sorwar (1997). Their main result was that default-free bond prices and contingent claim prices are sensitive to the underlying interest rate model used in these currencies. Given the differences in the volatility-level effects in Australia, Japan, and the UK, we are interested in investigating three other major countries as this will have important implications for the choice of model to be used in trading in these different international markets. In this paper, we apply the Box Method of Barone-Adesi et al. using historical estimates of the CKLS model from monthly Euro-currency rates for Canada, Hong Kong, and the United States.

The outline of the paper is as follows: Section 2 introduces the CKLS model, briefly discuses the Box Method of Barone-Adesi et al. (1997), and the Gaussian estimation approach of Nowman (1997). The data set used in the study is also presented. Section 3 presents the implied bond and contingent claims prices. Section 4 contains some conclusions.

2. Interest rate models

The CKLS model below allows the conditional mean and variance to depend on the level of rates r

$$dr(t) = \{\alpha + \beta r(t)\}dt + \sigma r(t)^{\gamma}dz \tag{1}$$

where $\{r(t),t>0\}$ is a real continuous time random process, α, β, σ, γ are unknown parameters. In particular, the CKLS model incorporates a drift element α, a mean reversion parameter β, σ is the volatility of the short-term rate, and γ is the proportional volatility exponent. The error dz is assumed to be a Wiener process. The CKLS model allows a number of models to be obtained by imposing restrictions on the parameters (see CKLS for a full list). In this paper, we consider the Vasicek (1977) model which is obtained by imposing $\gamma=0$ implying that conditional volatility of changes in the interest rate are constant, $dr(t)=\{\alpha+\beta r(t)\}dt+\sigma dz$. The second model considered is the CIR model, which is obtained by imposing $\gamma=0.5$ and allows a volatility-level effect in the model, $dr(t) = \{\alpha + \beta r(t)\}dt + \sigma\sqrt{r(t)}dz$. Lastly, we consider the BS model which imposes $\gamma=1$ on the CKLS model and allows a proportional volatility-level effect, $dr(t)=\{\alpha+\beta r(t)\}dt+\sigma r(t)dz$.