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Pricing Treasury Inflation Protected Securities and Related Derivatives using an HJM Model

Robert Jarrow and Yildiray Yildirim*

Abstract

This paper uses an HJM model to price TIPS and related derivative securities. First, using the market prices of TIPS and ordinary U.S. Treasury securities, both the real and nominal zero-coupon bond price curves are obtained using standard coupon bond price stripping procedures. Next, a three-factor arbitrage-free term structure model is fit to the time-series evolutions of the CPI-U and the real and nominal zero-coupon bond price curves. Then, using these estimated term structure parameters, the validity of the HJM model for pricing TIPS is confirmed via its hedging performance. Lastly, the usefulness of the pricing model is illustrated by valuing call options on the inflation index.

I. Introduction

In January 1997, the U.S. Treasury started issuing inflation indexed bonds. Inflation indexed bonds called TIPS—Treasury Inflation Protected Securities—differ from conventional bonds in that the principal is constantly adjusted for inflation, modifying the semi-annual interest payments accordingly. The index for measuring the inflation rate is the Consumer Price Index for all urban consumers, hereafter referred to as the CPI-U (see Roll (1996)), and lagged by two months. The two-month lag is the time interval necessary for the data collection process and the tabulation of the CPI-U index. As such, TIPS provide (approximate) default-free real returns.

The purpose of this paper is to apply an HJM model to consistently price (and hedge) both TIPS, conventional U.S. Treasury bonds, and related derivative securities. The HJM foreign currency analogy (see Jarrow and Turnbull (1998)) is used to implement this methodology. Indeed, we consider a hypothetical cross-currency economy under the no-arbitrage assumption where nominal dollars cor-

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