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A Simple Method For Pricing Interest Rate Swaptions

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amount of the variance in returns can be explained by tighter or looser restrictions in specific instances.

10. The F-value, used in multiple regressions, performs a function analogous to that of the t-statistic used in testing individual variables. There is no standard cutoff point to indicate that an F-value demonstrates statistical validity; instead, the required value is indirectly a function of the number of observations and the number of variables.
11. In this respect, the data constraints that compelled us to use a comparatively short observation period of just six months proved, in the end, to be an advantage. Factor instability would have been more troublesome if values had had more time to change.
12. While we were at it, we tested the government funds for percentage of variance "explained" by past performance. Replicating our high-yield methodology, we calculated an R^2 of 25.53 per cent and a 2.111 t-statistic. Evidently, success breeds success, even when there are other factors that are correlated with returns.
13. Leon Schkolnick of Merrill Lynch, Lori Lucas of Morningstar Inc. and Michael Lipper of Lipper Analytical Services, Inc. were instrumental in the production of this study.

A Simple Method for Pricing Interest Rate Swaptions

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Swaptions are long-dated interest rate options that closely resemble many of the embedded options found in fixed income securities and insurance liabilities. They are useful instruments for hedging long-dated option risk. The "commoditization" of swaptions and the growing efficiency of the market make them increasingly attractive to asset managers and insurance companies, which have to manage interest rate risk exposure and option risk.

Basically, a swaption is an option to enter into (or close out) an interest rate swap. Most outstanding swaptions (over 90 per cent) are European style. That is, they represent an option on a swap that starts at a future date—i.e., a forward swap. The going rate for such a forward swap would be the current forward rate.

This article describes a simple method for pricing European-style swaptions using Black's 1976 option-pricing model.[1] The procedure involves the following steps.

1. Derive an interest-rate-swap spot rate curve.
2. Calculate the forward rate of the swaption from the curve.
3. Using the forward rate as the underlying price in a "Black 76" commodity option model, calculate the option price.[2]
4. Annuitize the "Black 76" option model price for the term of the swaption.

Calculating the Option Price

The appendix describes the method used to derive the spot swap curve.[3] Table I gives sample results for a seven-year period. Using the semiannual spot rates given by this method, one can calculate the semiannual forward rates from the following formula:

$$1 + {}_nf_j = \frac{(1 + R_{n+j})^{n+j}}{(1 + R_n)^n}$$

where

f = the forward rate,
n = the point in time at which the rate is effective and
j = the period of time over which it applies.

With semiannual compounding, this rate must be divided by two and the exponents multiplied by two. Consider, as an example, a forward semiannual swap beginning five years from now and having a term of two years (i.e., ending in seven years). A forward swap beginning in five years for a term of two years is conventionally described as a "seven/five" swap.

1. Footnotes appear at end of article.

Table I Bootstrap Swap Curve

Years:	*0.5*	*1*	*1.5*	*2*	*2.5*	*3*
Swap Rate YTM:	8.8700	9.0400	**9.1550**	9.2700	9.3150	9.3600
Coupon:	0.04435	0.04520	0.04578	0.04635	0.04658	0.04680
Semi. Spot	8.8700%	9.0438%	9.1629%	9.2843%	9.3309%	9.3789%
Dis. Fac.	0.957533	0.915346	0.874250	0.834014	0.796129	0.759595
For. Val.	1.044350	1.092483	1.143837	1.199021	1.256079	1.316492
Ann. Spot:	9.0667%	9.2483%	9.3728%	9.4998%	9.5486%	9.5989%

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