Risky Bonds and Futures Asset Pricing

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The global bond market is the main component of the capital market, being about three times larger than the global equity markets. In 2009, the global bond market (total outstanding debt) was estimated to be $82.2 trillion; the US dominated the bond market with the outstanding U.S. bond debt at approximately $35.2 trillion[1]. Risk-free forward interest rates – and their realization by US Treasury bonds as the leading exemplar – have been studied extensively. The bond market considers US Treasury bonds as being risk-free instruments and consequently have the lowest yields. In [1], models of risk free bonds and their forward interest rates based on the quantum field theoretic formulation of the risk-free forward interest rates have been discussed, including the empirical evidence supporting these models. The quantum finance formulation of risk-free forward interest rates is extended to the case of risky forward interest rates. The example of the Singapore and Malaysian forward interest rates are used as a specific case of risky bonds. The main feature of the quantum finance model is that the risky forward interest rates are modelled both as a stand-alone case as well as being driven by the US forward interest rates, plus a spread – having its own term structure – above the US forward interest rates. Sovereign bonds of the developed as well as emerging countries are considered to be risky bonds and are benchmarked against the US risk free interest rates; the spread above the US rates is determined by the country specific risk.

A mathematical model has been developed in [6], with the spread of risky interest rates above the risk-free rates being modelled with a complete term structure. The formalism of quantum finance has been employed for the modelling. An empirical calibration of the model has been carried out for the US Treasury bonds as well as the Singapore and Malaysian sovereign bonds. Both the US forward interest rates and the term structure for the risky bond spread are modelled by a two-dimensional Euclidean quantum field.

The calibration and testing of the proposed model for the Singapore sovereign bond shows good results. As a precursor to the evaluation of a put option of the Singapore coupon bond, the quantum finance model for swaptions is tested using an empirical study of US Dollar swaptions; market data shows that the model is quite accurate. A prediction for the market price of the put option for the Singapore coupon bonds is obtained using the quantum finance formulation of the Singapore forward interest rates. The quantum finance model is generalized to study the Malaysian case and the model's prediction for a Malaysian interest rate swap is obtained.

The Malaysian forward interest rates are shown to have anomalies absent for the US and Singapore case. The statistical theory of asset prices has been formulated by [2]. Further empirical studies of single [3] and multiple commodity prices [4] have provided strong evidence in support of the primary assumptions of the statistical formulation. A model has been proposed by [5] that extends the model for spot prices [2] to model futures commodity asset prices using a statistical field theory of futures prices. The futures prices are modelled as a two-dimensional statistical field and a nonlinear Lagrangian is postulated. Empirical studies provide clear evidence in support of the model, with many nontrivial features of the model finding unexpected support from market data.

> **"US dominated the bond market with the outstanding US bond debt at approximately $35.2 trillion"**

References

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