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FIELDS OF SPECIALIZATION : Econometrics, International Economics

Ph.D. THESIS

Title : Une méthode d'inférence bayésienne pour les modèles espace-état affines faiblement identifiés appliquée à une stratégie d'arbitrage statistique de la dynamique de la structure à terme des taux d'intérêt

Thesis supervisor : William J. McCausland

EDUCATION

2009 : Ph.D. in Economics, Université de Montréal
1998 : M.Sc. in Economics, Université de Montréal
1996 : B.Com. Honors in Economics and Finance, McGill University
2007 : Financial Risk Manager (FRM), Global Association of Risk Professionals
2002 : CFA Chart Holder, AIMR

PROFESSIONAL ACTIVITIES

4/2009 – present : Senior Economist, Financial Stability Department, Bank of Canada
1/2007 - 1/2008 : Visiting Instructor, Department of Economics, Bilkent University
3/2004 – 3/2009 : Research analyst (part time), CDP Capital
07/2002 - 10/2003 : Consultant, CDP Capital
11/2001 - 07/2002 : Associate Director, CDP Capital, Global Markets Management Information Systems
04/1999 - 11/2001 : Financial Analyst, CDP Capital, Fixed Income Management Information Systems
06/1998 - 12/1998 : Student Financial Analyst, CDP Capital, Fixed Income Financial Engineering
11/1997 - 11/2003 : President, Le Café-terrasse 1957 Inc.

PAPERS AND PUBLICATIONS

"Forecasting with Weakly Identified Linear State-Space Models", Working paper.
"Bayesian Analysis of Affine Term Structure Models", Working paper.
"Statistical Arbitrage with Affine Term Structure Models", Working paper.

RESEARCH WORKS

Bayesian financial econometrics, Asset pricing, Forecasting, Decision theory, Factor models, Term structure of interest rates, MCMC methods.

REFERENCES

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SUMMARY OF THE THESIS

UNE MÉTHODE D'INFÉRENCE BAYÉSIENNE POUR LES MODÈLES ESPACE ÉTAT AFFINES FAIBLEMENT IDENTIFIÉS APPLIQUÉE À UNE STRATÉGIE D'ARBITRAGE STATISTIQUE DE LA DYNAMIQUE DE LA STRUCTURE À TERME DES TAUX D'INTÉRÊT

This topic of this thesis is Bayesian inference for affine interest rate term structure models. In particular, it highlights the importance of parameter normalization and observational error specification on the quality of the forecasts generated by an affine model. At the methodological level, I propose a new Markov Chain Monte Carlo sampler for affine term structure models. Using weekly Government of Canada bond prices, I show that predictive densities generated by an affine model can help identify statistical arbitrage strategies generating economically significant profits net of execution costs.

The first chapter, *Forecasting with Weakly Identified Linear State-Space Models*, highlights the importance parameter normalization on the quality of the forecasts generated by Gaussian linear state space models. Because the likelihood function of these models is invariant with respect to parameter transformations corresponding to linear transformations of the factors, the maximum likelihood parameter estimator is not unique. Thus, one normalizes the model by considering a subspace of the parameter space. Ideally, normalization should satisfy two criteria. First, normalization should not introduce any observational restriction as this would result in a loss in modeling flexibility. Second, it should ensure global parameter identification. If this latter criterion is not satisfied, normalization is likely to introduce weak identification problems which could yield a strongly biased maximum likelihood estimator. Any forecast using this estimator would also be biased. In contrast, Bayesian predictive densities do not rest on a parameter point estimator, which makes Bayesian predictions more robust to weak identification. Using simulations, I compare the performance of Bayesian and maximum likelihood forecasts, on the basis of out-of-sample root mean square errors, and I find that the advantage of Bayesian forecasts increases as sign identification becomes weaker.

The second chapter, *Bayesian Analysis of Affine Term Structure Models*, specializes the results of the first chapter to affine interest rate term structure models. In particular, I use an innovative normalization ensuring the global identification. Moreover, I highlight the importance of observational error specification on the inference for these models. I show that a common specification where the error covariance matrix does not have full rank can produce errors that are more strongly serially correlated than a specification with full rank. Beyond this particular case, I highlight the role prior specification of the error covariance matrix. Because an affine model decomposes the term structure into a number of common factors and idiosyncratic errors, the specification of latter's covariance matrix affects this decomposition directly. For example, the modeling of independently and identically distributed errors ask factors to describing correlations between discount rates and the term structure of volatility, whether they are of common or idiosyncratic origin. On the other hand, modeling general errors makes it possible to associate factors the common components more directly. At the methodological level, I propose a new Markov Chain Monte Carlo sampler for affine term structure models.

The final chapter, *Statistical Arbitrage with Affine Term Structure Models*, uses the results of the preceding chapters to evaluate the utility of affine models for arbitrage portfolio construction. Statistical arbitrage consists in betting on temporary market price deviations from those given by a model. In order to neutralize the risk associated to common factors, I consider portfolios whose value is approximately uncorrelated with factors. In spite of an obvious misspecification problem, the predictive density generated by the model allows one to identify portfolios generating economically significant profits. For example, expected gains and 5% weekly value-at-risk have significant predictive power. Applied to Government of Canada bonds at a weekly frequency between 2001 and 2006, the strategy generates profits in the order of one basis point of execution cost out of sample for the year 2007.