Rotman Finance PhD Course RSM 3034. Spring 2017

Topics in Empirical Asset Pricing

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Preliminary Course Outline. This Version: 12 January 2017

Class time: Fridays, 1:30-4:30. First class is January 13, 2017. See exceptions below.

Class room: 470. 105 St George Street. See exceptions below.

Preliminary List of Topics Covered

Part I: Dynamic Models for Individual Assets and Factors

1) January 13: Forecasting market returns
2) January 20: Volatility and distribution modeling using GARCH
3) January 27: Volatility and distribution modeling using realized volatility

Part II: Derivative Pricing Models

4) February 3: Option valuation in GARCH models. Option-implied moments
5) February 10: Pricing kernels, stochastic volatility, and realized volatility
6) February 16, 1:30-4:30 in 374: Factor structure in options. Option portfolio management

Part III: Factor Models for Cross-Sectional Asset Pricing

7) February 24: Factor theory and portfolio management. Criteria for factors
8) March 3: February 30: Classic and new factors. Factors across markets
9) March 9, 1:30-4:30 in 127: Volatility-based and option-implied factors
10) March 10: Skewness-based factors

Part IV: Dynamic Models for Multiple Assets and Factors

11) March 31 in 374: Dynamic covariance, correlation and beta
12) April 7: Risk factor modeling using dynamic copulas

13) April 13, 1:30-4:30 in 127: Student presentations

Student Deliverables

Your grade will be based on the following:

- Matlab exercises will be assigned 3 times during the course: 45% of grade
  - Timing: Due by email on: February 3, February 24, March 31.
- Student presentation of own research idea (25 minutes): 45% of grade
  - Timing: April 13.
- Class participation: 10% of grade
  - Timing: Throughout the course

Preliminary List of Readings

All readings will be available in the Dropbox folder.

1) Forecasting market returns

- *Rapach and Zhou (2013), Forecasting Stock Returns, Handbook of Economic Forecasting, Vol 2A.*
- *Kelly and Pruitt (2013), Market Expectations in the Cross Section of Present Values, JF.*
- Campbell and Thompson (2008), Predicting Excess Stock Returns Out of Sample: Can Anything Beat the Historical Average? RFS.
- Kelly and Pruitt (2015), The Three-Pass Regression Filter: A New Approach to Forecasting Using Many Predictors, J.Econm.
- Ross (2005), Neoclassical Finance, pp. 54-59.
- Moller and Rangvid (2015), End-of-the-year Economic Growth and Time-varying Expected Returns, JFE.
- Garleanu and Pedersen (2013), Dynamic Trading with Predictable Returns and Transaction Costs, JF.
- Cieslak, Morse and Vissing-Jorgensen (2016), Stock Returns over the FOMC Cycle, SSRN.
- Huang, Jiang, Tu, Zhou (2015), Forecasting Stock Returns in Good and Bad Times: The Role of Market States, SSRN.
- Etula, Rinne, Suominen, and Vaittinen (2016), Dash for Cash: Month-End Liquidity Needs and the Predictability of Stock Returns. SSRN.
- Ringenberg, Rapach, and Zhou (2016), Short Interest and Aggregate Stock Returns, Journal of Financial Economics.
- Martin (2017), What is the Expected Return on the Market?, QJE.

2) Volatility and distribution modeling using GARCH

- *EFRM Chapter 4 and 6.*
- Andersen, Bollerslev, Christoffersen and Diebold (**ABCD**, 2013), Financial Risk Measurement for Financial Risk Management, in Handbook of Economics of Finance, Volume 2. Section 2 only.
- Engle and Rangel (2008), The Spline-GARCH Model for Low-Frequency Volatility and Its Global Macroeconomic Causes, RFS.

- *Engle, Ghysels and Sohn (2013), Stock Market Volatility and Macroeconomic Fundamentals, REStat.*
- Bloom (2014), Fluctuations in Uncertainty, JEP.
- Jurado, Ludvigson and Ng (2015), Measuring Uncertainty, AER.
- Engle and Siriwadane (2016), Structural GARCH: The Volatility Leverage Connection, SSRN

3) Volatility and distribution modeling using realized volatility

- EFRM Chapter 5. ABCD Section 2 only.
- McCurdy and Maheu (2011), Do high-frequency measures of volatility improve forecasts of return distributions? Journal of Econometrics.
- Hansen, Huang and Shek (2012), Realized GARCH: A Joint Model for Returns and Realized Measures of Volatility, JAE.
- Patton and Verardo (2013), Does Beta Move with News? Firm-Specific Information Flows and Learning about Profitability. RFS.
- Chen and Ghysels (2011), News—Good or Bad—and Its Impact on Volatility Predictions over Multiple Horizons. RFS.
- Fleming, Kirby, and Oestdiek, (2002), The Economic Value of Volatility Timing using Realized Volatility, JFE.
- Bollerslev, Osterrieder, Sizova and Tauchen (2013), Risk and return: Long-run Relations, Fractional Cointegration, and Return Predictability. JFE.
- Engle and Sokalska (2012), Forecasting intraday volatility in the US equity market. Multiplicative component GARCH. JFEC.
- Johannes and Stroud (2015), Bayesian modeling and forecasting of 24-hour high-frequency volatility, JASA.

4) Option valuation in GARCH models. Option-implied moments.

- Christoffersen, Jacobs, and Ornthanalai (2013), GARCH Option Valuation: Theory and Evidence, Journal of Derivatives.
- Heston and Nandi (2000), A Closed-form GARCH Option Valuation Model, RFS.
- Bakshi, Kapadia and Madan (2003), Stock Return Characteristics, Skew Laws, and the Differential Pricing of Individual Equity Options, RFS.
- Christoffersen, Elkamhi, Feunou and Jacobs (2010), Option Valuation with Conditional Heteroskedasticity and Non-Normality, RFS.
- Christoffersen, Dorion, Jacobs and Wang (2010), Volatility Components: Affine Restrictions and Non-normal Innovations. JBES.
- Christoffersen, Jacobs, Ornthanalai and Wang (2008), Option Valuation with Long-run and Short-run Volatility Components. JFE.
- Babaoglu, Christoffersen, Heston and Jacobs (2016), Option Valuation with Volatility Components, Fat Tails, and Non-Monotonic Pricing Kernels, SSRN.

5) Pricing kernels, stochastic volatility, and realized volatility

- Christoffersen, Heston and Jacobs (2013), Capturing Option Anomalies with a Variance-Dependent Pricing Kernel, RFS.
- Heston (1993), A Closed-Form Solution for Options with Stochastic Volatility with Applications to Bond and Currency Options, RFS.
- Christoffersen, Jacobs and Mimouni (2010), Volatility Dynamics for the S&P500: Evidence from Realized Volatility, Daily Returns, and Option Prices, RFS.
- Christoffersen, Heston and Jacobs (2009), The Shape and Term Structure of the Index Option Smirk: Why Multifactor Stochastic Volatility Models Work so Well, ManSci.
- Dorion (2015), Option Valuation with Macro-Finance Variables, JFQA.
- Song and Xiu (2016), A Tale of Two Option Markets: State-price Densities and Volatility Risk, JEconm.
- Christoffersen, Feunou and Jeon (2016), Option Valuation with Observable Volatility and Jump Dynamics, JBF.
- Christoffersen, Feunou, Jeon, and Ornthanalai (2016), Time-Varying Crash Risk: The Role of Stock Market Liquidity, SSRN.

6) Factor structure in options. Option portfolio management.

- Christoffersen, Fournier, and Jacobs (2014), Factor Structure in Equity Options. SSRN.
- Faias and Santa-Clara (2017), Optimal Option Portfolio Strategies, JFQA.
- Broadie, Chernov and Johannes (2009), Understanding Index Option Returns. RFS.
- Boyer and Vorkink (2014), Stock Options as Lotteries, JF.
- Malamud (2014), Portfolio Selection with Options. SSRN.

7) Factor Theory and portfolio management. Criteria for factors.

- Cochrane (2000) Asset Pricing, Chapter 9.
- Ang (2014) Asset Management, Chapter 6.
- Maio and Santa-Clara (2012), Multifactor models and their consistency with the ICAPM, JFE.
- CAPM proof.
- Cochrane (1999), Portfolio Advice for a Multifactor World, SSRN.
- Brandt, Santa-Clara and Valkanov (2009), Parametric Portfolio Policies: Exploiting Characteristics in the Cross-Section of Equity Returns, RFS.
- Garleanu and Pedersen (2013), Dynamic Trading with Predictable Returns and Transaction Costs, JF.

8) Classic and new factors. Factors across markets

- Fama and French (2015), A Five-Factor Asset Pricing Model, JFE.
- Fama and French (2015), Dissecting Anomalies with a Five-Factor Model, RFS.
- Frazzini and Pedersen (2014), Betting against Beta, JFE.
- Asness, Frazzini, and Pedersen (2014), Quality Minus Junk, SSRN.com.
- Asness, Moskowitz and Pedersen (2013), Value and Momentum Everywhere, JF.
- Koijen, Moskowitz, Pedersen, Vrugt (2013), Carry, SSRN.com

- Moskowitz, Ooi and Pedersen (2012), Time Series Momentum, JFE.
- Hou, Xue, and Zhang (2015), Digesting Anomalies: An Investment Approach, RFS, 2015.
- McLean and Pontiff (2015), Does Academic Research Destroy Stock Return Predictability? JF.
- Novy-Marx (2013), The other Side of Value: The Gross Profitability Premium, JFE.
- Barroso and Santa-Clara (2015), Momentum has its Moments, JFE.

9) Volatility-based and option-implied factors

- Christoffersen, Jacobs and Chang (2013), Forecasting with Option Implied Information, Handbook of Economic Forecasting, Volume 2A.
- Chang, Christoffersen, Jacobs, and Vainberg (2012), Option-Implied Measures of Equity Risk, RF.
- Ang, Hodrick, Xing and Zhang (2006), The Cross-Section of Volatility and Expected Returns, JF
- Christoffersen and Pan (2014), Oil Volatility Risk and Expected Stock Returns. SSRN.
- Christoffersen and Pan (2014), Equity Portfolio Management Using Option Price Information, SSRN.
- Cremers, Halling and Weinbaum, (2015), Aggregate Jump and Volatility Risk in the Cross-Section of Stock Returns, JF.
- Duarte, Kamara, Siegel and Sun (2014), The Systematic Risk of Idiosyncratic Volatility, SSRN.
- Herskovic, Kelly, Lustig, and Van Nieuwerburgh (2016) The Common Factor in Idiosyncratic Volatility: Quantitative Asset Pricing Implications, JFE.
- Chen and Petkova (2012) Does Idiosyncratic Volatility Proxy for Risk Exposure? RFS.

10) Skewness-based factors

- Chang, Christoffersen and Jacobs (2013), Market skewness risk and the cross section of stock returns, JFE.
- Amaya, Christoffersen, Jacobs and Vasquez (2015), Does Realized Skewness Predict the Cross-Section of Equity Returns? JFE.
- Neuberger, (2012), Realized Skewness, RFS.
- Christoffersen, Fournier, Jacobs and Karoui (2016), The Conditional Price of Coskewness and Cokurtosis Risk: A New Approach, SSRN.
- Conrad, Dittmar and Ghysels (2013), Ex Ante Skewness and Expected Stock Returns, JF.

11) Dynamic covariance, correlation and beta

- ABCD, Section 3.
- EFRM Chapters 7 and 8.
- Christoffersen, Jacobs, Jin, and Errunza (2014), Correlation dynamics and international diversification benefits, International Journal of Forecasting.
- Bali, Engle and Tang (2017), Dynamic Conditional Beta is Alive and Well in the Cross-Section of Daily Stock Returns, ManSci.
- Gilbert, Hrdlicka, and Siegel (2014), Daily Data is Bad for Beta: Opacity and Frequency-Dependent Betas, RAPS.
- Hansen, Lunde, and Voev (2014), Realized Beta GARCH: A Multivariate GARCH Model with Realized Measures of Volatility.

- Engle and Rangel (2012). The Factor-Spline-GARCH Model for High- and Low-frequency Correlations, JBES.
- Brownlees and Engle (2016), SRISK: A Conditional Capital Shortfall Index for Systemic Risk Measurement, SSRN.

12) Risk factor modeling using dynamic copulas

- EFRM, Chapter 9.
- Christoffersen, Errunza, Jacobs and Langlois (2012), Is the Potential for International Diversification Disappearing? A Dynamic Copula Approach, RFS
- Christoffersen and Langlois (2013), The Joint Dynamics of Equity Market Factors, JFQA
- Christoffersen, Jacobs, Jin, and Langlois (2016), Dynamic Dependence and Diversification in Corporate Credit, SSRN.

13) Student presentations

Matlab Homework 1. Due February 3 by email.

a) Replicate Figures 1 and 2 in Rapach and Zhou's Handbook chapter. Replicate Figures 3 and 4 but only for Kitchen Sink and Pool-Avr. Note: You don't need to include the NBER dates in the figures. Use the updated data set from Amit Goyal's webpage.
b) Using daily total returns on the S&P500 from 1/1/1992 through 31/12/2016 estimate an HN-GARCH(1,1) model with Gaussian errors. Show the ACF of the raw returns, the squared returns and the GARCH squared residuals. Show the QQ plots of raw returns and GARCH residuals. Estimate the NGARCH model also and compare fit with the HN-GARCH model.
c) Using the RV data supplied in xlsx illustrate the stylized facts of RV from EFRM Chapter 5.
d) Using the RV data supplied in xlsx estimate a HAR model on the RV for 1-day, 5-day and 10-day log variance. How well does the model fit the data?
e) Compute average RV (use 5 minute log returns) and average BPV using the one-minute log returns supplied for S&P500 index in the .mat file. The variables in the mat file are:
1st column: Date in YYYYMMDD,
2nd column: Time in HHMM (Hour and Minute) Eg) 931 represents 9:31 AM.
3rd column: One-minute Return. Eg) Return for 931 represents return from 9:30 AM to 9:31 AM of the day.

Matlab Homework 2. Due February 24 by email.

a) Code up the Heston-Nandi GARCH(1,1) option valuation model. Confirm the two option prices at the bottom of page 620. Verify the formula using Monte Carlo simulation.

b) Code up the Heston SV option valuation model. Reproduce Figure 4 in Heston (RFS, 1993). Discretize the model and verify the pricing formula using Monte Carlo simulation.

c) Use the option data circulated. The variables are:
(1) date (matlab)
(2) date (yyyymmdd)
(3) days to maturity
(4) strike
(5) mid-price
(6) ex-dividended underlying price
(7) interest rate
(8) call/put flag (call=1, put=0) (9)highest bid (10)lowest ask
(11) trading volume
(12) open interest
(13) BS-IV from OptionMetrics (if 0, it means N/A)
(14) optionID
(15) last traded date (yyyymmdd, if =0, it means N/A)
(16) own BS-IV for comparison with (13)
(17) weekday indicator

For each day available in 2003, compute the 30-day option-implied variance, skewness and kurtosis using the formulas in Bakshi, Kapadia and Madan (RFS, 2003). Plot each moment over time in a 3 by 1 subplot. The data has already been filtered. Use the following implementation procedure in Chang, Christoffersen and Jacobs (JFE, 2013) to compute the moments:

"We estimate only the moments for days that have at least two OTM call prices and two OTM put prices available. Because we do not have a continuity of strike prices, we calculate the integrals using cubic splines. For each maturity, we interpolate implied volatilities using a cubic spline across moneyness levels (K/S) to obtain a continuum of implied volatilities. For moneyness levels below or above the available moneyness level in the market, we use the implied volatility of the lowest or highest available strike price. After implementing this interpolation-extrapolation technique, we obtain a fine grid of one thousand implied volatilities for moneyness levels between 0.01% and 300%. We then convert these implied volatilities into call and put prices using the following rule: Moneyness levels smaller than 100% (K/S<1) are used to generate put prices and moneyness levels larger than 100% (K/S > 1) are used to generate call prices using trapezoidal numerical integration. Linear interpolation between maturities is used to calculate the moments at a fixed 30-day horizon."

Matlab Homework 3. Due March 31 2 by email.

To be announced.