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**McGill University**
**Fall 2018**

## FINE-703: Empirical Research in Finance

**Prof. Sergei Sarkissian**

<http://sergei-sarkissian.com>

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Class Time:	MON 08:35-11:25
Class Location:	ARM 375
Office Hours:	MON 11:30-12:00 & by appointment
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### Prerequisites:

PhD-level Introduction to Financial Economics  
 PhD-level Time Series Econometrics  
 Basic programming and data management skills

### Course Description:

This course covers a range of empirical studies of financial markets. The primary emphasis is on the asset pricing literature. The topics in this area include time-series return predictability, cross-sectional market anomalies, tests of single- and multi-factor risk-return models, consumption-based asset pricing. Other related areas, such as fund performance evaluation, event studies, and behavioral finance will be discussed as well. The course covers several methodological aspects of empirical finance research such as the concept of stochastic discount factor (SDF), GMM-based estimation of parameters of asset pricing models, modern mean-variance efficiency bounds, and some issues in long-run abnormal return measurement and panel studies. Most of asset pricing tests will be performed in both unconditional and conditional settings.

### Course Objectives:

The main objective of the class is to create a high quality discussion on each empirical finance topic that we will study. If this goal is achieved, then this course will help you:

- A. Understand and critically evaluate empirical studies in finance.
- B. Develop methodological skills that you could efficiently use in your own research.
- C. Think about a potential dissertation topic.

## Course Materials:

- Campbell, J, A. Lo, and C. MacKinlay, 1997, *The Econometrics of Financial Markets*, Princeton University Press.
- Cochrane, J., 2005, *Asset Pricing*, Princeton University Press.
- Ferson, W., 1995, Theory and Empirical Testing of Asset Pricing Models, Chapter 5 in *Finance, Handbooks in Operations Research and Management Science*, by Jarrow, R., V. Maksimovic and W. Ziemba (eds), Elsevier, 145-200.

I have also listed relevant articles for each class topic (see Detailed Reading List). The papers marked with ☼ are mandatory for reading, while the underlined papers require a short written review. In addition, you will be required to use some statistical software package for your assignments and other potential empirical work. You can choose any application package you feel more comfortable with, but the most useful ones for this class are those that have good matrix-based computing capabilities, such as *Matlab*. You should make your software available to yourself by the end of the second week of classes.

## Grading:

Assignment 1:	10%
Assignment 2:	15%
Assignment 3:	20%
Presentation:	25%
Final Exam:	30%

Assignment #1: You will analyze the time-series dynamics of asset returns.

Assignment #2: You will test the CAPM using Fama-MacBeth regression method.

Assignment #3: You will test CCAPMs using GMM and Hansen-Jagannathan bounds.

Presentation: You will have to choose a topic from the reading list and prepare a one-hour presentation. **At least one week** before your presentation, you should meet with me to go over the preliminary outline of your talk. At that time, you should be at least 50% prepared for the task. The meeting time should be set with me in advance. The student-led presentations will start from the fourth week of classes.

Final Exam: The final is a **48-hour** take-home exam. You will have to write a referee report on an empirical finance paper that I will assign individually to each student. To prepare your report, you will be able to use any books and articles available in the library and on the internet, but you may not seek help from other people. Towards the end of the semester, I will set up a date and a time range (for your flexibility) when you would be able to pick up your paper to referee. The 48-hour count will start from the time you pick your paper.

You **must** read the assigned materials for each class ahead of time. Do not expect to know every detail in the textbooks or papers (some of them are very hard to read). However, you should make a good effort to understand the new topic to the point that it would allow you to share the responsibility for class discussions with me and other students.

## Course Schedule

<b>Date</b>	<b>Topic</b>	<b>Remarks</b>
<i>Sep. 7</i>	<b>Introduction</b>	
Sep. 10	<b>Generalized Method of Moments</b>	
Sep. 17	<b>Hansen-Jagannathan Bounds and Distance</b>	
<i>Sep. 21</i>	<b>Time-Series Dynamics of Asset Returns:</b> Autocorrelation, Mean-Reversion, Momentum, Volatility	
Sep. 24	<b>Time-Series Dynamics of Asset Returns:</b> Return Predictability with Information Variables	
Oct. 1	<b>Tests of CAPM:</b> Unconditional and Conditional Approaches	<b>Assign. 1 due</b>
<i>Oct. 12</i>	<b>Cross-Sectional Return Anomalies</b>	
Oct. 22	<b>Tests of APT:</b> Unconditional and Conditional Approaches	
Oct. 29	<b>Tests of Consumption CAPMs:</b> Complete Markets, Time Separable, Long-Run Risk Models	<b>Assign. 2 due</b>
Nov. 5	<b>Tests of Consumption CAPMs:</b> Habit Persistence and Incomplete Market Models	
Nov. 12	<b>Fund Performance Evaluation:</b> Unconditional and Conditional Approaches	
Nov. 19	<b>Behavioral Finance:</b> Familiarity, Overconfidence, Herding, Investor Sentiment	<b>Assign. 3 due</b>
Nov. 26	<b>Review</b>	

## Detailed Reading List

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### 1. Introduction (1 week)

CLM, Chapter 1  
JC, Chapter 1  
WF, Section 1-2.

### 2. Generalized Method of Moments (1 week)

JC, Chapter 10-11.  
WF, Section 3.2

Hansen, L., 1982, Large sample properties of generalized method of moments estimators, *Econometrica* 50, 1029-1054.

### 3. Hansen-Jagannathan Bounds and Distance (1 week)

CLM, Chapter 8.1  
JC, Chapter 5.6  
WF, Section 3.1

Hansen, L., and R. Jagannathan, 1991, Implications of security market data for models of dynamic economies, *Journal of Political Economy* 99, 225-262.

Hansen, L., and R. Jagannathan, 1997, Assessing specific errors in stochastic discount factor models, *Journal of Finance* 52, 557-590.

### 4. Time-Series Dynamics of Asset Returns (2 weeks)

CLM, Chapter 2  
JC, Chapter 20.1

*Auto-correlation, Mean Reversion, Momentum, Volatility:*

Cohen, L., and A. Frazzini, 2008, Economic links and predictable returns, *Journal of Finance* 63, 1977-2011. ☼

Daniel, K., and T. Moskowitz, 2016, Momentum crashes, *Journal of Financial Economics* 122, 221-247.

Fama, E. and K. French, 1988, Permanent and temporary components of stock prices, *Journal of Political Economy* 96, 246-273. ☼

Jegadeesh, N., and S. Titman, 1993, Returns to buying winners and selling losers: Implications for stock market efficiency, *Journal of Finance* 48, 65-91.

Lo, A., and C. MacKinlay, 1990, When are contrarian profits due to stock market overreaction? *Review of Financial Studies* 3, 175-205.

Keim, D., 1983, Size-related anomalies and stock return seasonality: Further empirical evidence, *Journal of Financial Economics* 12, 13-32.

- McQueen, G., M. Pinegar, and S. Thorley, 1996, Delayed reaction to good news and the cross-autocorrelation of portfolio returns, *Journal of Finance* 51, 889-919.
- Shiller, R., 1981, Do stock prices move too much to be justified by subsequent changes in dividends?, *American Economic Review* 71, 421-436. ☼

*Return Predictability with Information Variables:*

- Ang, A., and G. Bekaert, 2007, Stock return predictability: Is it there?, *Review of Financial Studies* 20, 651-707. ☼
- Campbell, J. and M. Yogo, 2006, Efficient tests of stock return predictability, *Journal of Financial Economics* 81, 27-60.
- Fama, E., and G. Schwert, 1977, Asset returns and inflation, *Journal of Financial Economics* 5, 115-146.
- Fama, E., and K. French, 1988, Dividend yields and expected stock returns, *Journal of Financial Economics* 22, 3-25.
- Fama, E., and K. French, 1989, Business conditions and expected returns on stocks and bonds, *Journal of Financial Economics* 25, 23-49. ☼
- Ferson, W., S. Sarkissian, and T. Simin, 2003, Spurious regressions in financial economics?, *Journal of Finance* 58, 1393-1413. ☼
- Goyal, A., and I. Welch, 2008, A comprehensive look at the empirical performance of equity premium prediction, *Review of Financial Studies* 21, 1455-1508.
- Torous, W., R. Valkanov, and S. Yan, 2005, On predicting stock returns with nearly integrated explanatory variables, *Journal of Business* 77, 937-966.

## 5. Tests of CAPM (1 week)

CLM, Chapter 5  
JC, Chapter 9.1

*Unconditional:*

- Ang, A., J. Chen, and Y. Xing, 2006, Downside risk, *Review of Financial Studies* 19, 1191-1239.
- Campbell, J. and T. Vuolteenaho, 2004, Good beta, bad beta, *American Economic Review* 94, 1249-1275. ☼
- Fama, E., and J. MacBeth, 1973, Risk, return, and equilibrium: Empirical tests, *Journal of Political Economy* 91, 607-636.
- Gibbons, M., Ross, S. and J. Shanken, 1989, A test of the efficiency of a given portfolio, *Econometrica* 57, 1121-1152.
- Roll, R., 1977, A critique of the asset pricing theory's tests, *Journal of Financial Economics* 4, 129-176. ☼
- Shanken, J., 1985, Multivariate tests of the zero-beta CAPM, *Journal of Financial Economics* 14, 327-348.

*Conditional:*

- Harvey, C., 1989, Time varying conditional covariances in tests of asset pricing models, *Journal of Financial Economics* 24, 289-317. ☼
- Harvey, C., 1991, The world price of covariance risk, *Journal of Finance* 46, 111-157.

- Lewellen, J., and S. Nagel, 2006, The Conditional CAPM does not explain asset-pricing anomalies, *Journal of Financial Economics* 82, 289-314. ☼
- Nagel, S., and K. Singleton, 2011, Estimation and evaluation of conditional asset pricing models, *Journal of Finance* 66, 873-909.

## 6. Cross-Sectional Return Anomalies (1 week)

CLM, Chapter 5.8, 6  
JC, Chapter 12.2, 20.2  
WF, Section 3.7

- Daniel, K., and S. Titman, 1997, Evidence on the characteristics of cross sectional variation in stock returns, *Journal of Finance* 52, 1-33. ☼
- Fama, E., and K. French, 1993, Common risk factors in the returns on stocks and bonds. *Journal of Financial Economics* 33, 3-56.
- Fama, E., and K. French, 2015, A five-factor asset pricing model, *Journal of Financial Economics* 116, 1-22. ☼
- Ferson, W., S. Sarkissian, and T. Simin, 1999, The alpha factor asset pricing model: A parable, *Journal of Financial Markets* 2, 49-68.
- Harvey, C., Y. Liu, and H. Zhu, 2016, ...and the cross-section of expected returns, *Review of Financial Studies* 29, 5-68.
- Hou, K., C. Xue, and L. Zhang, 2015, Digesting anomalies: An investment approach, *Review of Financial Studies* 28, 650-705.

## 7. Tests of APT (1 week)

CLM, Chapter 6  
JC, Chapter 9.4

### *Unconditional:*

- Asness, C., T. Moskowitz, and L. Pedersen, 2013, Value and momentum everywhere, *Journal of Finance* 68, 929-985.
- Chan, L., J. Karceski and J. Lakonishok, 1998, The risk and return from factors, *Journal of Financial and Quantitative Analysis* 33, 159-187. ☼
- Chen, N., 1983, Some empirical tests of arbitrage pricing, *Journal of Finance* 38, 1393-1414.
- Chen, N., R. Roll, and S. Ross, 1986, Economic forces and the stock market: Testing the APT and alternative asset pricing theories, *Journal of Business* 59, 383-403. ☼

### *Conditional:*

- Ang, A., and D. Kristensen, 2012, Testing conditional factor models, *Journal of Financial Economics* 106, 132-156.
- Ferson, W. and C. Harvey, 1991, The variation of economic risk premiums, *Journal of Political Economy* 99, 385-415. ☼
- Jagannathan, R. and Z. Wang, 1996, The conditional CAPM and the cross-section of expected returns, *Journal of Finance* 51, 3-54. ☼

Ludvigson, S., and S. Ng, 2007, The empirical risk-return relation: A factor analysis approach, *Journal of Financial Economics* 83, 171-222.

## 8. Tests of Consumption CAPMs (2 weeks)

CLM: Chapter 8.2-8.4

JC, Chapters 2, 21

*Complete Markets, Time Separable CCAPMs:*

Hansen, L., and K. Singleton, 1983, Stochastic consumption, risk aversion, and the temporal behavior of asset returns, *Journal of Political Economy* 91, 249-265.

Kocherlakota, N., 1996, The equity premium: It's still a puzzle, *Journal of Economics Literature* 34, 42-71. ☼

Lettau, M. and S. Ludvigson, 2001, Resurrecting the C(CAPM): A cross-sectional test when risk premia are time-varying, *Journal of Political Economy* 109, 1238-1287. ☼

Yogo, M., 2006, A consumption-based explanation of expected stock returns, *Journal of Finance* 61, 539-580.

*Long-Run CCAPMs*

Bansal, R. and A. Yaron, 2004, Risks for the long run: A potential resolution of asset pricing puzzles, *Journal of Finance* 59, 1481-1509. ☼

Bansal, R., R. Dittmar, and C. Lundblad, 2005, Consumption, dividends, and the cross-section of equity returns, *Journal of Finance* 60, 1639-1672.

Hansen, L., J. Heaton, and N. Li, 2008, Consumption strikes back? Measuring long-run risk, *Journal of Political Economy* 91, 249-265. ☼

Ferson, W., S. Nallareddy, and B. Xie, 2013, The out-of-sample performance of long-run risk models, *Journal of Financial Economics* 107, 537-556.

*CCAPMs with Habit Persistence:*

Boldrin, M., L. Christiano, and J. Fisher, 2001, Habit persistence, asset returns, and the business cycle, *American Economic Review* 91, 149-166.

Campbell J. and J. Cochrane, 1999, By force of habit: A consumption-based explanation of aggregate stock market behavior, *Journal of Political Economy* 107, 205-251. ☼

Ferson, W. and G. Constantinides, 1991, Habit persistence and durability in aggregate consumption: Empirical tests, *Journal of Financial Economics* 29, 199-240. ☼

Santos, T. and P. Veronesi, 2010, Habit formation, the cross section of stock returns and the cash-flow risk puzzle, *Journal of Financial Economics* 98, 385-413.

*Incomplete Markets CCAPMs:*

Brav, A., G. Constantinides, and C. Geczy, 2002, Asset pricing with heterogeneous consumers and limited participation: Empirical evidence, *Journal of Political Economy* 110, 793-824. ☼

Storesletten K., C. Telmer, and A. Yaron, 2004, Cyclical dynamics in idiosyncratic labor market risk, *Journal of Political Economy* 112, 695-717.

Sarkissian, S., 2003, Incomplete consumption risk sharing and currency risk premiums, *Review of Financial Studies* 16, 983-1005. ☼

Telmer, C., 1993, Asset-pricing puzzles and incomplete markets, *Journal of Finance* 48, 1803-32.

## 9. Fund Performance Evaluation (1 week)

### *Unconditional:*

Amihud, Y., and R. Goyenko, 2013, Mutual fund's R2 as a predictor of performance, *Review of Financial Studies* 26, 667-695.

Carhart, M., 1997, On persistence in mutual fund performance, *Journal of Finance* 52, 57-82.

Chen, J., H. Hong, M. Huang, and J. Kubik 2004, Does fund size erode mutual fund performance? The role of liquidity and organization, *American Economic Review* 94, 1276-1302.

Cremers, M., and A. Petajisto, 2009, How active is your fund manager? A new measure that predicts performance, *Review of Financial Studies* 22, 3329-3365. ☼

Daniel, K., M. Grinblatt, S. Titman, and R. Wermers, 1997, Measuring mutual fund performance with characteristic-based benchmarks, *Journal of Finance* 52, 1035-1058. ☼

Kacperczyk, M., C. Sialm, and L. Zheng, 2008, Unobserved actions of mutual funds, *Review of Financial Studies* 21, 2379-2416.

### *Conditional:*

Barras, L., O. Scaillet, and R. Wermers, 2010, False discoveries in mutual fund Performance: measuring luck in estimated alphas, *Journal of Finance* 65, 179-216.

Ferson, W., and R. Schadt, 1996, Measuring fund strategy and performance in changing economic conditions, *Journal of Finance* 51, 425-461. ☼

Christopherson, J., W. Ferson, and D. Glassman, 1998, Conditioning manager alphas on economic information: another look at the persistence of performance, *Review of Financial Studies* 11, 111-142. ☼

Christoffersen, S., and S. Sarkissian, 2009, City size and fund performance, *Journal of Financial Economics* 92, 252-275.

## 10. Behavioral Finance (1 week)

### *Familiarity:*

Coval, J., and T. Moskowitz, 1999, Home bias at home: Local equity preference in domestic portfolios, *Journal of Finance* 54, 2045-2073. ☼

French, K., and J. Poterba, 1991, Investor diversification and international equity markets, *American Economic Review* 81, 222-226.

Massa, M., and A. Simonov, 2006, Hedging, familiarity, and portfolio choice, *Review of Financial Studies* 19, 633-685.

Sarkissian, S., and M. Schill, 2004, The overseas listing decision: New evidence of proximity preference, *Review of Financial Studies*, 17, 769-809.

### *Herding:*

Clement, M., and S. Tse, 2005, Financial analyst characteristics and herding behavior in forecasting, *Journal of Finance*, 60, 307-341.

Sias, R., 2004, Institutional herding, *Review of Financial Studies* 1, 165-206. ☼



Welch, I., 2000, Herding among security analysts, *Journal of Financial Economics* 58, 369-396.

Wermers, R., 1999, Mutual fund herding and the impact on stock prices, *Journal of Finance* 54, 581-622.

*Investor Sentiment:*

Baker, M., and J. Wurgler, 2006, Investor sentiment and the cross-section of stock returns, *Journal of Finance* 61, 1645-1680. ☼

Barber, B., and T. Odean, 2008, All that glitters: The effect of attention and news on the buying behavior of individual and institutional investors, *Review of Financial Studies* 21, 785-818.

Lee, C., A. Shleifer, and R. Thaler, 1991, Investor sentiment and closed end fund puzzle, *Journal of Finance*, 46, 75-110.

Stambaugh, R., J. Yu, and Y. Yuan, 2012, The short of it: Investor sentiment and anomalies, *Journal of Financial Economics* 104, 288-302.

*Loss Aversion, Overconfidence:*

Barber, B., and T. Odean, 2000, Trading is hazardous to your wealth: The common stock investment performance of individual investors, *Journal of Finance* 55, 773-806.

Frazzini, A., 2006, The disposition effect and underreaction to news, *Journal of Finance* 61, 2017-2046.

Malmendier, U., and G. Tate, 2008, Who makes acquisitions? CEO overconfidence and the market's reaction, *Journal of Financial Economics* 89, 20-43.

Odean, T., 1998, Are investors reluctant to realize their losses?, *Journal of Finance* 53, 1775-1798. ☼

## **Assignment #1**

### **Dynamics of Asset Returns**

#### **A. Auto- and cross-asset correlations:**

Select two firms, large and small, in the same country and industry, and download daily returns on these two firms. Give a brief summary for your selection. You must have at least twenty years of observations. Both *CRSP* and *Datastream* can be used here. Provide the “Summary statistics” and “Cross-correlation” tables for your returns.

Construct weekly autocorrelations of returns on your two assets for each day of the week. Perform the same exercise on two sub-periods. Explain any autocorrelation patterns.

Construct daily lead-lag cross-autocorrelations between your large and small firms. Perform the same exercise on two sub-periods. Explain any patterns.

#### **B. The January effect:**

Use the ten daily size portfolios from Ken French’s web site<sup>1</sup> and examine the January effect, i.e. whether your portfolio returns in are higher January than during the rest of the year.

Regress daily excess returns of your ten portfolios on 11 monthly dummies from February to December. The intercept from this regression will show the excess return in January. As a proxy for the risk-free rate take the daily US T-bill rate from Ken French’s site.

Perform the whole-sample and sub-sample estimations. Explain any patterns. Use OLS as well as robust Newey-West standard errors. Explain differences in statistical inference (if any).

#### **C. Information variables:**

Select a country and construct US dollar denominated monthly excess returns on your country index. You must have at least 240 observations. Use the US T-bill as a proxy for risk-free rate in any market. Select two market information variables and explain your choice. *Datastream* is the best source of data here. Provide the “Summary statistics” and “Cross-correlation” tables for your country and all instruments that you use in your analysis.

Perform the whole-sample and sub-sample estimations. Discuss economic and statistical results, including the observed signs of the regression coefficients, t-statistics, adjusted R-squares, and other relevant information.

Perform the out-of-sample estimation. Use the regression output from the first sub-sample to predict your country return a month ahead. Repeat this procedure using the “moving-window” technique for the rest of the sample. Using the root mean squared errors (RMSE), compare your results with the forecast based on the sample mean return.

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<sup>1</sup> Download from [http://mba.tuck.dartmouth.edu/pages/faculty/ken.french/data\\_library.html](http://mba.tuck.dartmouth.edu/pages/faculty/ken.french/data_library.html) the file called “Portfolios Formed on Size [Daily].”

## Assignment #2

### Testing the World CAPM with Fama-MacBeth Regression Methodology

#### A. The base test of the WCAPM:

The regression model is as follows:

$$r_{i,t} = \lambda_{0,t} + \lambda_{w,t} \hat{\beta}_{iw,t-1} + \zeta_{it}, \quad i = 1, \dots, N, \quad (1)$$

where  $r_{i,t}$  is the country  $i$  excess return at time  $t$ ,  $\hat{\beta}_{iw,t-1}$  is the estimate of the beta from regressing country  $i$  returns on the world market index based on the previous 60 months of data, for a period ending at time  $t-1$ . Each month, the Fama-MacBeth regression produces estimates of the intercept,  $\lambda_{0,t}$ , and the world market premium,  $\lambda_{w,t}$ . Use the average coefficients over time and the Fama-MacBeth t-ratios to test the hypothesis that the average premium associated with the world market risk is positive and that the average pricing error is zero.

#### B. Testing the WCAPM with country-specific risk:

Test the WCAPM against the specific alternative hypothesis that the pricing errors in (1) are related to the omission of the general country-specific risk. The new regression model is:

$$r_{i,t} = \lambda_{0,t} + \lambda_{w,t} \hat{\beta}_{iw,t-1} + \lambda_{s,t} \hat{s}_{i,t-1} + \xi_{i,t}, \quad i = 1, \dots, N, \quad (2)$$

where  $\hat{s}_{i,t-1}$  is the log volatility of residuals from regressing country  $i$  returns on the world market index based on the previous 60 months of data, for a period ending at time  $t-1$ , while  $\lambda_{s,t}$  is the premium associated with country risk. The goal here is to see if the average premium  $\lambda_s$  is zero.

#### C. Testing the WCAPM with firm attribute factors:

Let the alternative hypothesis is that the pricing errors in model (1) are related to the omission of some firm-attribute related risk in each country. The new regression model is:

$$r_{i,t} = \lambda_{0,t} + \lambda_{w,t} \hat{\beta}_{iw,t-1} + \lambda_{a,t} A_{i,t-1} + \zeta_{i,t}, \quad i = 1, \dots, N, \quad (3)$$

where  $A_{i,t-1}$  is the lagged firm attribute for country  $i$ , known at time  $t-1$  and  $\lambda_{A,t}$  is the attribute-related risk premium. Consider one firm attribute, e.g., book-to-market (B/M) ratio, earnings-to-price (E/P) ratio, market capitalization, etc. The goal here is to see if the average premium  $\lambda_A$  is zero.

*Data source and description:* The frequency of data is monthly. The number of time-series observations is at least 240. The cross-sectional observations (countries), as well as country-specific firm attribute-based factors should come from Ken French's web site.<sup>2</sup> All returns must be denominated in US dollars. As a risk-free rate use the one-month US T-bill.

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<sup>2</sup> See "International Research Returns Data" file.

### Assignment #3

## Testing Consumption CAPMs using GMM and HJ Bounds

#### A. Test of complete markets CCAPM:

Consider the standard power utility CCAPM in the following Euler equation form:

$$\rho E_{t-1} \left[ \left( \frac{C_t}{C_{t-1}} \right)^{-\alpha} R_{i,t} \right] = 1, \quad i = 1, \dots, N, \quad (1)$$

where  $\rho$  is the time preference parameter (pure time discount factor),  $C_t$  is the world real per capita consumption at time  $t$ ,  $\alpha$  is the risk aversion (concavity) parameter, and  $R_{i,t}$  is the gross real rate of return to an investor from holding an asset  $i$  one period. Use the real per capita consumption growth rates from G5 countries to compute the world real per capita consumption growth. You should have at least 30 years of quarterly data. For asset returns, use US dollar denominated market returns across G5 countries from Datastream plus a riskless asset – the one-month US T-bill. Your goal is to estimate the parameters of risk aversion,  $\alpha$ , and time preference,  $\rho$ . The instrument set should include a constant, the lagged world real per capita consumption growth, and the lagged world dividend yield.

#### B. Test of incomplete markets CCAPM:

Consider the following Euler equation:

$$\rho E_{t-1} \left[ \left( \frac{C_t}{C_{t-1}} \right)^{-\alpha} \exp \left( \frac{\alpha^2 + \alpha}{2} d_t \right) R_{i,t} \right] = 1, \quad i = 1, \dots, N, \quad (2)$$

where  $d_t$  is the consumption dispersion at time  $t$ ,  $d_t = \text{Var}[\ln(C_{i,t} / C_{i,t-1})]$ , where  $C_{i,t}$  is the world real per capita consumption of country  $i$  at time  $t$ . Your goal is to estimate parameters  $\rho$  and  $\alpha$  and compare them with those from model (1). The return and instrument sets are as in Part A.

#### C. Constructing Hansen-Jagannathan bounds

The HJ bounds establish the relation between the variance,  $\hat{\sigma}_m^2$ , of the minimum-variance pricing kernel,  $m$ , with the expected value  $E(m)$ , namely:

$$\hat{\sigma}_m^2 = [I - E(m)\bar{\mathbf{R}}]' S^{-1} [I - E(m)\bar{\mathbf{R}}], \quad (3)$$

where  $\bar{\mathbf{R}}$  is the  $N$ -dimensional vector of mean gross asset returns and  $S$  is the sample variance-covariance matrix of asset returns. You should compute and plot the Hansen-Jagannathan lower volatility bounds for country equity market portfolio returns. Then you should depict the sample mean and volatility of the implied pricing kernel for your two CCAPMs when  $\alpha = 5$ .