Applied Econometric Time Series

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Session 1

Introduction

Introduction:
The Nature and Purpose of Econometrics

- What is Econometrics?

- Literal meaning is “measurement in economics”.

- Definition of financial econometrics:

  The application of statistical and mathematical techniques to problems in finance.
- Definition of macroeconometrics:

  The application of statistical and mathematical techniques to problems in macroeconomy.

Examples of the kind of problems that may be solved by a Financial Econometrician

1. Testing whether financial markets are weak-form informationally efficient.

2. Testing whether the CAPM or APT represent superior models for the determination of returns on risky assets.

3. Measuring and forecasting the volatility of asset returns.

4. Testing technical trading rules to determine which makes the most money.

5. Testing whether spot or futures markets react more rapidly to news.

Examples of the kind of problems that may be solved by a Macroeconometrician

1. Main determinants and impact of Foreign Direct Investments.

2. Determine the impact of the monetary policy on outputs.

3. The determinants of inflation.

4. Estimate Taylor rules.

5. The impact of (real) exchange-rate movements on exports.

What are the Special Characteristics of Financial Data?

- *Frequency & quantity of data*

  Stock market prices are measured every time there is a trade or somebody posts a new quote.

- *Quality*

  Recorded asset prices are usually those at which the transaction took place. No possibility for measurement error but financial data are "noisy".

Types of Data and Notation

- There are 3 types of data which econometricians might use for analysis:
  1. Time series data
  2. Cross-sectional data
  3. Panel data, a combination of 1. & 2.

- The data may be quantitative (e.g. exchange rates, stock prices, number of shares outstanding), or qualitative (e.g. day of the week).

- Examples of *time series data*

Series	*Frequency*
GNP or unemployment	monthly, or quarterly
government budget deficit	annually
money supply	weekly
value of a stock market index	as transactions occur

Time Series versus Cross-sectional Data

- Examples of *Problems that Could be Tackled Using a Time Series Regression*
  - How the value of a country's stock index has varied with that country's macroeconomic fundamentals.
  - How the value of a company's stock price has varied when it announced the value of its dividend payment.
  - The effect on a country's currency of an increase in its interest rate

- Cross-sectional data are data on one or more variables collected at a single point in time, e.g.
  - A poll of usage of internet stock broking services
  - Cross-section of stock returns on the New York Stock Exchange
  - A sample of bond credit ratings for UK banks

Cross-sectional and Panel Data

- Examples of *Problems that Could be Tackled Using a Cross-Sectional Regression*
  - The relationship between company size and the return to investing in its shares
  - The relationship between a country's GDP level and the probability that the government will default on its sovereign debt.

- Panel Data has the dimensions of both time series and cross-sections, e.g. the daily prices of a number of blue chip stocks over two years.

- It is common to denote each observation by the letter t and the total number of observations by T for time series data, and to to denote each observation by the letter i and the total number of observations by N for cross-sectional data.

Continuous and Discrete Data

- Continuous data can take on any value and are not confined to take specific numbers.
- Their values are limited only by precision.
  - For example, the rental yield on a property could be 6.2%, 6.24%, or 6.238%.
- On the other hand, discrete data can only take on certain values, which are usually integers
  - For instance, the number of people in a particular underground carriage or the number of shares traded during a day.
- They do not necessarily have to be integers (whole numbers) though, and are often defined to be count numbers.
  - For example, until recently when they became 'decimalised', many financial asset prices were quoted to the nearest 1/16 or 1/32 of a dollar.

Cardinal, Ordinal and Nominal Numbers

- Another way in which we could classify numbers is according to whether they are cardinal, ordinal, or nominal.

- *Cardinal numbers* are those where the actual numerical values that a particular variable takes have meaning, and where there is an equal distance between the numerical values.
  - Examples of cardinal numbers would be the price of a share or of a building, and the number of houses in a street.

- *Ordinal numbers* can only be interpreted as providing a position or an ordering.
  - Thus, for cardinal numbers, a figure of 12 implies a measure that is `twice as good' as a figure of 6. On the other hand, for an ordinal scale, a figure of 12 may be viewed as `better' than a figure of 6, but could not be considered twice as good. Examples of ordinal numbers would be the position of a runner in a race.

Cardinal, Ordinal and Nominal Numbers (Cont'd)

- Nominal numbers occur where there is no natural ordering of the values at all.
  - Such data often arise when numerical values are arbitrarily assigned, such as telephone numbers or when codings are assigned to qualitative data (e.g. when describing the exchange that a US stock is traded on.
- Cardinal, ordinal and nominal variables may require different modelling approaches or at least different treatments, as should become evident in the subsequent chapters.

Returns in Financial Modelling

- It is preferable not to work directly with asset prices, so we usually convert the raw prices into a series of returns. There are two ways to do this:

  Simple returns or log returns

  $$R_t = \frac{p_t - p_{t-1}}{p_{t-1}} \times 100\% \qquad\qquad R_t = \ln\left(\frac{p_t}{p_{t-1}}\right) \times 100\%$$

  where, R_t denotes the return at time t

  p_t denotes the asset price at time t

  ln denotes the natural logarithm

- We also ignore any dividend payments, or alternatively assume that the price series have been already adjusted to account for them.

Log Returns

The returns are also known as log price relatives, which will be used throughout this book. There are a number of reasons for this:

1. They have the nice property that they can be interpreted as continuously compounded returns.

2. Can add them up, e.g. if we want a weekly return and we have calculated daily log returns:

$$r_1 = \ln p_1/p_0 = \ln p_1 - \ln p_0$$
$$r_2 = \ln p_2/p_1 = \ln p_2 - \ln p_1$$
$$r_3 = \ln p_3/p_2 = \ln p_3 - \ln p_2$$
$$r_4 = \ln p_4/p_3 = \ln p_4 - \ln p_3$$
$$r_5 = \ln p_5/p_4 = \ln p_5 - \ln p_4$$

$$\ln p_5 - \ln p_0 = \ln p_5/p_0$$

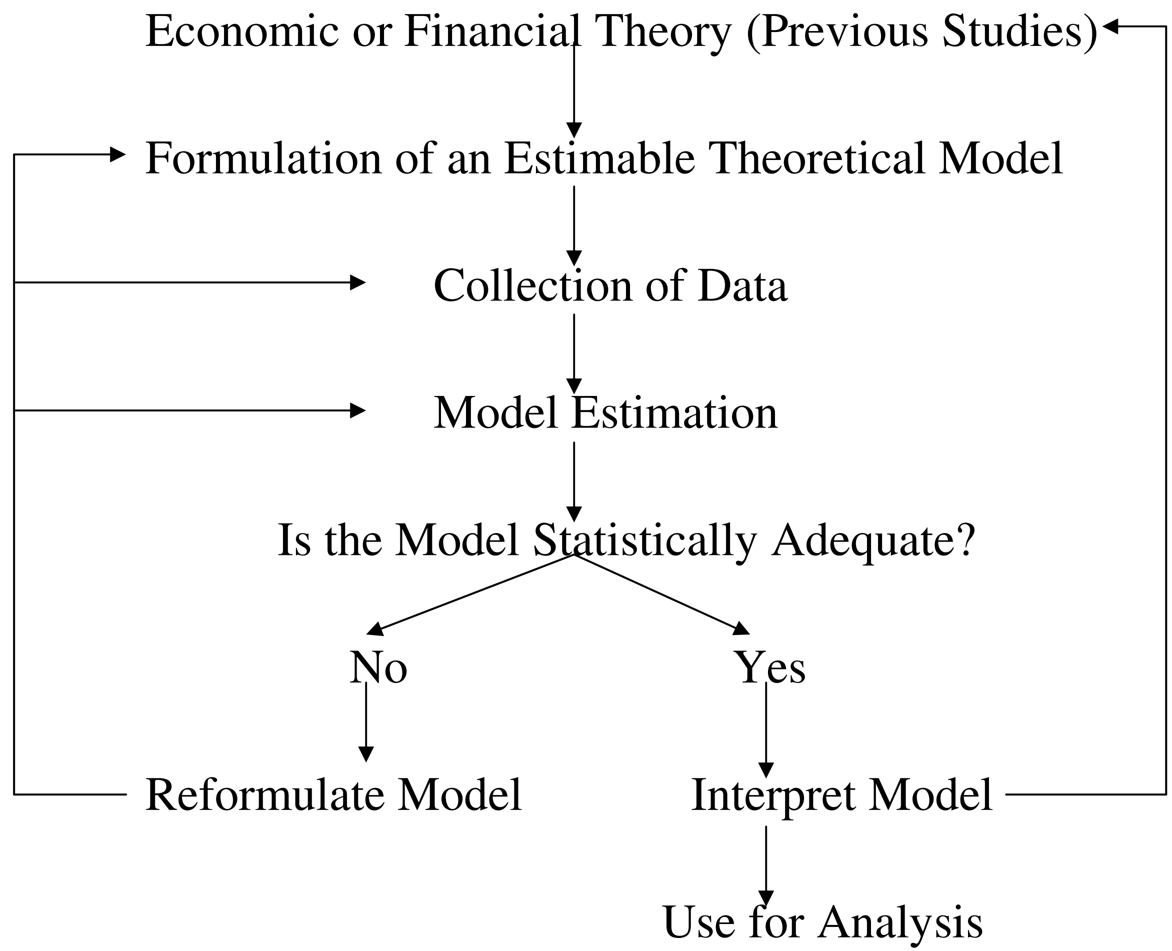
A Disadvantage of using Log Returns

- There is a disadvantage of using the log-returns. The simple return on a portfolio of assets is a weighted average of the simple returns on the individual assets:

$$R_{pt} = \sum_{i=1}^{N} w_{ip} R_{it}$$

- But this does not work for the continuously compounded returns.

Steps involved in the formulation of econometric models



Some Points to Consider when reading papers in the academic finance literature

1. Does the paper involve the development of a theoretical model or is it merely a technique looking for an application, or an exercise in data mining?

2. Is the data of "good quality"? Is it from a reliable source? Is the size of the sample sufficiently large for asymptotic theory to be invoked?

3. Have the techniques been validly applied? Have diagnostic tests for violations of been conducted for any assumptions made in the estimation of the model?

Some Points to Consider when reading papers in the academic finance literature (cont'd)

4. Have the results been interpreted sensibly? Is the strength of the results exaggerated? Do the results actually address the questions posed by the authors?

5. Are the conclusions drawn appropriate given the results, or has the importance of the results of the paper been overstated?

Find and Working with database

- Exercise 1. Go to the website of the “Federal Reserve Economic Data”

1.1 Represent with excel (sheet 1) the monthly US core inflation (January 1957-August 2009) ; seasonally adjusted.

1.2 Represent with excel (sheet 2) the default spread at weekly frequency (spread between Moody's Aaa and Baa Corporate Bond Yield)

1.3 Transform these weekly data in (end-of-month) monthly data (sheet 3)

Find and Working with database (cont'd)

- Exercise 2. Go to Yahoo Finance and download daily data of the CAC 40 index since January 1990.

1.1 Calculate daily returns (based on closing prices)

1.2 Calculate squared daily returns (volatility)

1.3 Intuitively, are squared returns non-autocorrelated?

1.4 Calculate the min, max, mean, standard deviation, variance, skewness and kurtosis of these daily returns. What do you observe?

1.5 Calculate the value of returns below which 5% of the returns fall

Accomplishing simple tasks using Eviews

1. Creating a workfile and importing data
   New /Workfile/ ("Monthly" "1991:01" "2007:05")
2. Import UK average house price data from January 1991 to May 2007 (197 obs.)
   File/Import ("UKHP.XLS")
3. Check the data (double click) and rename ("HP") by a right-click
4. Calculate simple percentage changes in the series
   Genr/ "DHP=100*(HP-HP(-1))/HP(-1)"
5. Compute summary statistics: dhp
   Quick/Series Statistics/Histogram and Stats "DHP"
6. Plot the data
   View/graph/Line/
7. Save your work
   File/saveas

Or more compactly without loss of information!

```
cd C:\data\session1
Program firstprg
'in the new window
workfile example1 m 1991:01 2007:05
read(B2,s=Monthly) ukhp.xls 1
rename average_house_price01  hp
genr dhp=100*(HP-HP(-1))/HP(-1)
hist dhp
plot dhp
save example1.wf1
```