

# Empirics of Financial Markets

Major issues – a review

# Coverage

- Empirical models with some theoretical contents

# Detailed list of issues covered (1/2)

- Equity market: explaining normal returns : CAPM and its extensions, APT)
- Financial markets at large: what explains prices and yields – random walk, efficient market hypothesis
- Financial markets at large: volatility modelling (ARCH/GARCH models)

# Detailed list of issues covered (2/2)

- Fixed income (debt) market: yield curve modelling (term structures of interest rates)
- FX market: basic theories of exchange rate level and dynamics, market microstructure

# CAPM and APT (1/4)

- **Systematic** (non-diversifiable) risk (*interest rates, business cycle*) vs. **unsystematic** (idiosyncratic) risk (*change of tax structure favoring some industries*)
- Major hypothesis: expected yield is a linear function of a covariance between that yield and market yield.

# CAPM and APT (2/4)

- Empirical formula: OLS

$$R_{it} = \alpha_i + \beta_i R_{mt} + \varepsilon_{it}$$

- CAPM testing:
  - Intercept equals 0;
  - $\beta$  is the only factor explaining yield differences.
- Two-stage estimation procedure (lab)

# CAPM and APT (3/4)

- Problems of CAPM:
  - Market portfolio unobservable
  - Number of factors too low ->APT popularity

# CAPM and APT (4/4)

- APT: allows many (not identified by the model) factors, does not require a market portfolio
- **Law of one price:** portfolios with the same factor sensitivities should have the same yield
- Empirical model: OLS

# Random walk

- (1900 r.) the oldest concept in quantitative finance

$$\Delta P_t = \mu + \varepsilon_t$$

- Random walk hypotheses:
  - RW1 - any functions of the increments are uncorrelated
  - RW2 - independent increments (but not their functions)
  - RW3 - uncorrelated increments

# Efficient Market Hypothesis (1/2)

- Efficiency may mean different things: allocative efficiency, transactional efficiency, informational efficiency...
- EMH: stock prices fully and correctly reflect all relevant information [Fama (1970)].

$$P_{t+1} = E[P_{t+1} | I_t] + \varepsilon_{t+1}$$

- Weak, semi-strong and strong efficiency

# EMH (2/2)

- **Weak efficiency:**
  - I includes past prices.
  - Technical analysis cannot bring abnormal returns
- **Semi-strong efficiency:**
  - I includes all public information
  - Both fundamental and technical analysis cannot bring abnormal returns
- **Strong efficiency:**
  - I includes all (also private) information (*inside information*).
  - Insider trading cannot bring abnormal returns.

# Volatility Modelling (ARCH/GARCH) (1/4)

- **Background:** Routine volatility models assumed homogenous error term - for most financial data error term variance usually varies upon time!
- Explicit variance modelling gives better volatility estimates and forecasts

# Volatility Modelling (ARCH/GARCH) (2/4)

- Stylized facts:
  - Leptokurtic distribution
  - Variance clustering
  - Leverage effect (a negative correlation between past returns and future volatility)

# Volatility Modelling (ARCH/GARCH) (3/4)

- ARCH(q)

$$\sigma_t^2 = \alpha_0 + \alpha_1 u_{t-1}^2 + \dots + \alpha_q u_{t-q}^2$$

- For a positive variance parameters estimates have to be positive
- A large number of parameters to be estimated

- GARCH(p,q)

$$\sigma_t^2 = \alpha + \alpha_1 u_{t-1}^2 + \dots + \alpha_q u_{t-q}^2 + \beta_1 \sigma_{t-1}^2 + \dots + \beta_p \sigma_{t-p}^2$$

- Parsimonious specification
- Problems with a leverage effect

# Volatility Modelling (ARCH/GARCH) (4/4)

- ARCH-in-mean
  - Allow for higher premia tied to higher risk (shown in data)
- GARCH-t
  - Fat tails in distribution of residuals

# Yield Curve (1/3)

- *Yield curve* depicts formally a term structure of interest rates
- Types of yield curve shape :
  - normal
  - flat
  - inverted
  - humped

# Yield Curve (2/3)

- Theoretical background :
  - Expectation theory
  - Liquidity preference theory
  - Market segmentation theory
  - Preferred habitat theory

# Yield Curve (3/3)

- Nelson-Siegel model
- Svensson model

# Forex market

- Purchasing power parity (PPP) (absolute, relative)
- Interest rate parity (covered, uncovered)
- Monetary models
- Market microstructure