Practical issues in ALM and Stochastic modelling for actuaries

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Objectives

- Demystify some terms
- Issues around model selection
- Awareness of key choices
- Practical problems in model/parameter selection
- Demystify market-consistency
- Practical problems with market-consistent valuations

Prudential Sourcebook (UK)

ICA (UK)

Target Surplus (Aus)

Basel II

IFRS

EEV

Because we have to

Why use Stochastic Models?

Because we want to

Optimising Asset Allocation

Real Options

Embedded Options e.g. NNEG

Guarantees on UL products

Alternative Investments – Risk/Return

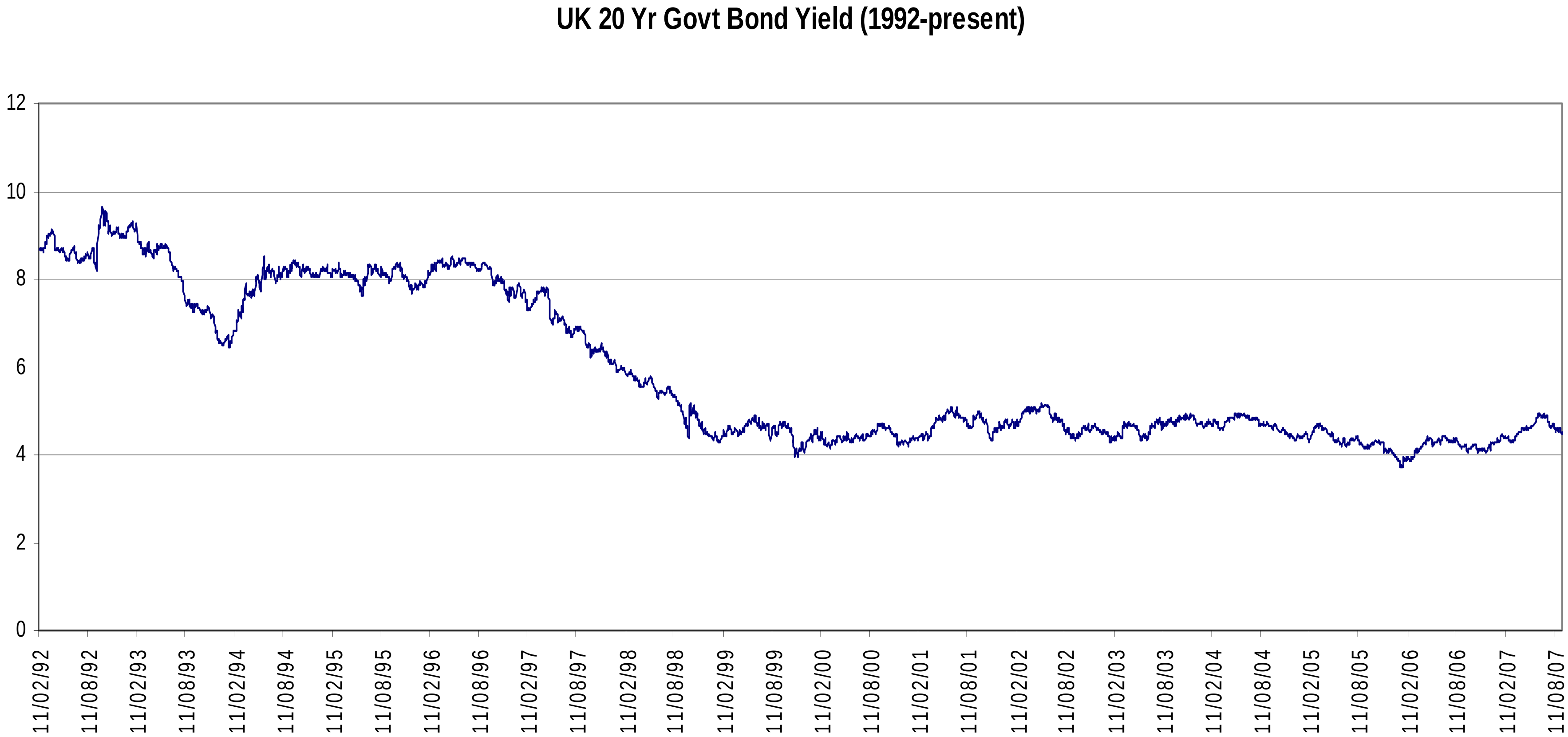
Model Features

- Mean reversion
- Fat-Tails
- Arbitrage
- Market-Consistent Calibration

Mean Reversion Graphically – Exchange Rates

ASD vs USD (1969-present)

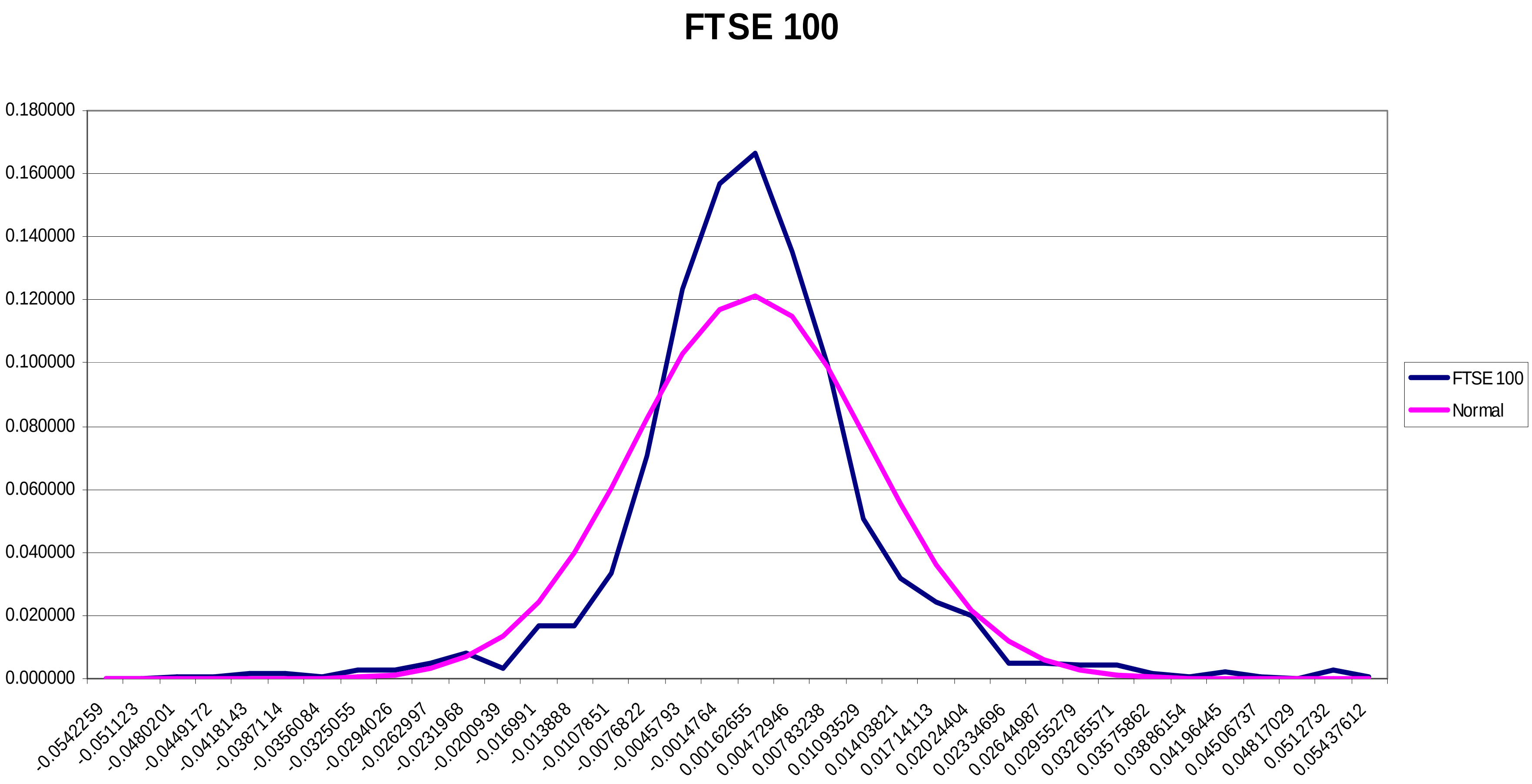
Mean reversion Graphically – Yields



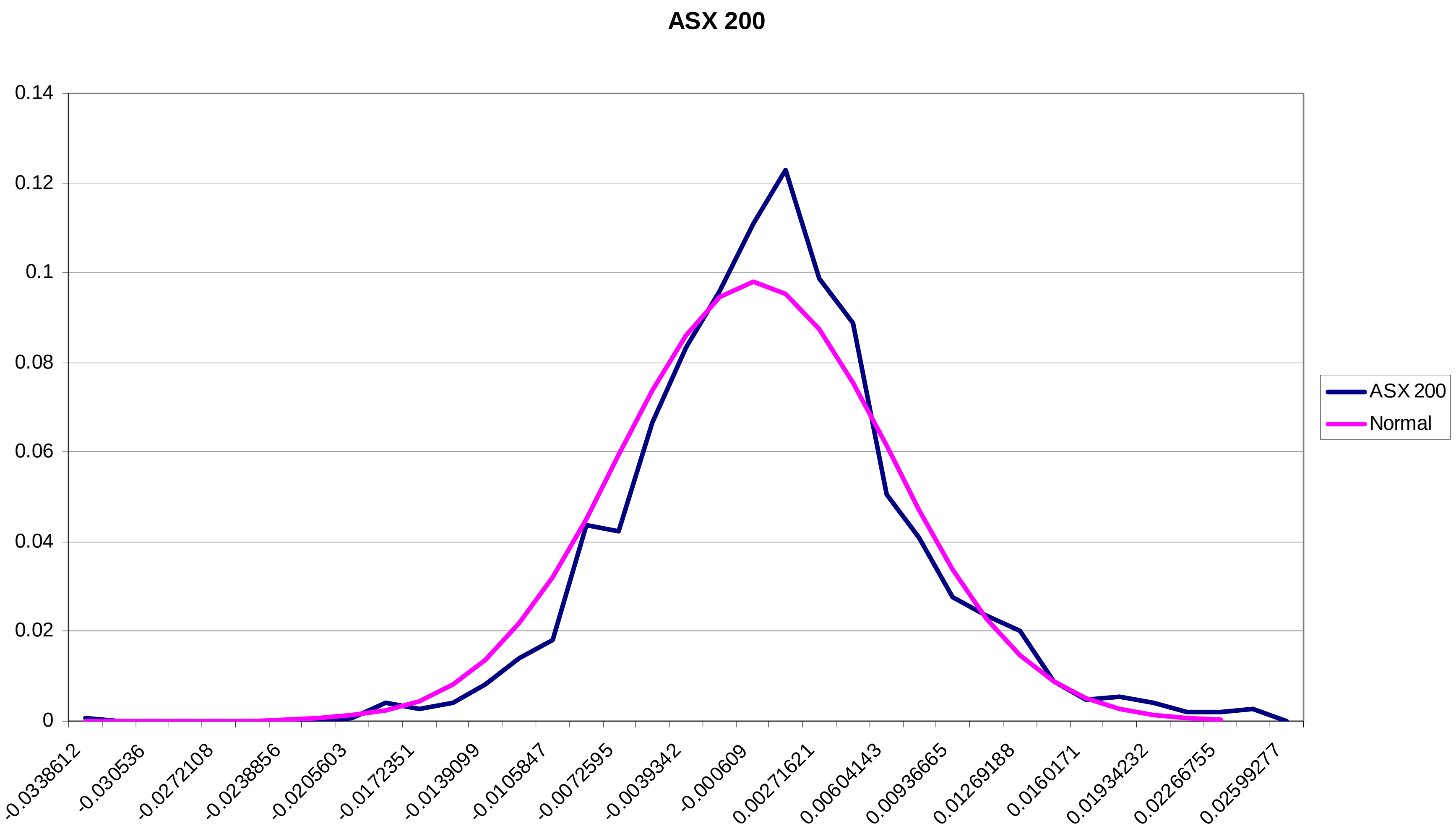
What is the Consensus?

Equity (Capital Values)	✗
Equity (Dividend Yield)	✓ Will differ over different industries
Bond Yields	✓ At least a band of activity
Inflation	✓ Developed countries – Inflation targeting
Exchange Rates	Possibly – PPP arguments

Graphically – Fat Tails



Graphically – Fat Tails



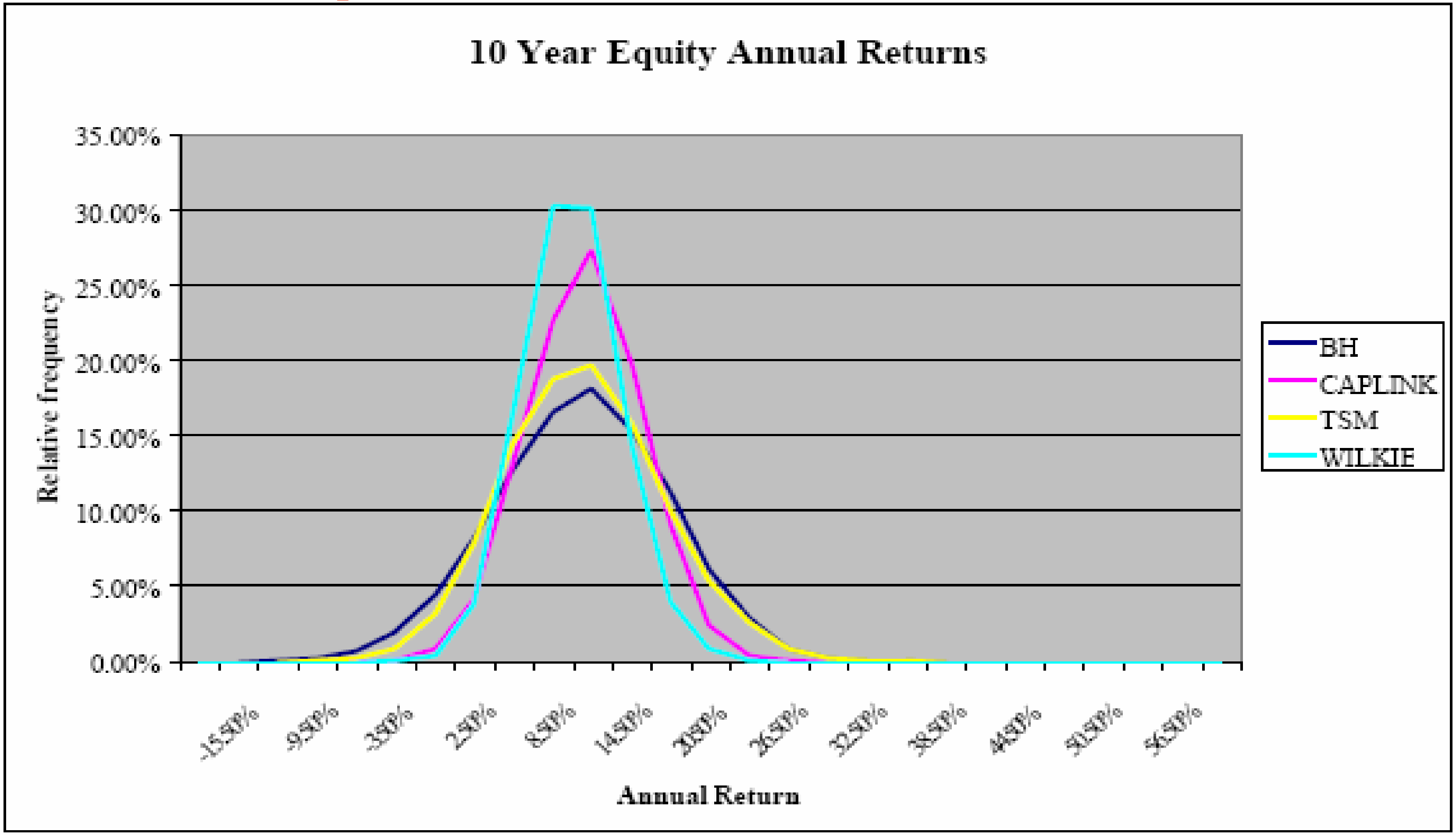
Arbitrage-Free

- A model that produces outputs permitting arbitrage opportunities implies that the user can predict certain future profits
- Modern models produce arbitrage-free outcomes e.g. yield curves

Market-Consistent Calibration

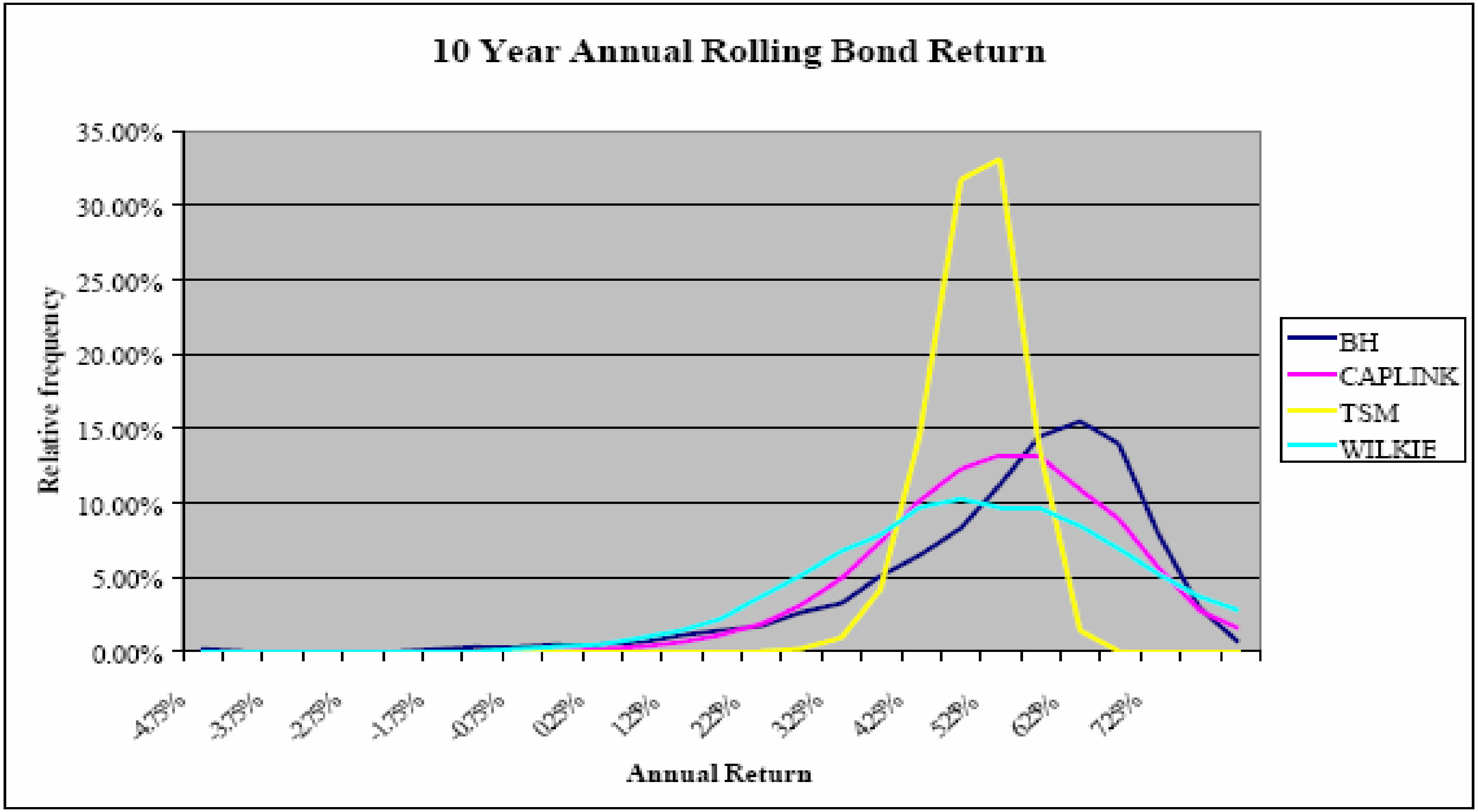
- Much demand for models that can produce market-consistent valuations
- That is, the ability to calibrate the model to current market prices
- Some models (e.g. The Smith Model, Barrie & Hibbert) are designed to incorporate MC calibrations
- Older ones e.g. Wilkie are not
- Importance depends on purpose of modelling

Impact of Model Choice



Source: Creedon S (and 10 other authors), 2003 *"Risk and Capital Assessment and Supervision in Financial Firms"*, Interim Working Party Paper, Finance and Investment Conference 2003.

Impact of Model Choice



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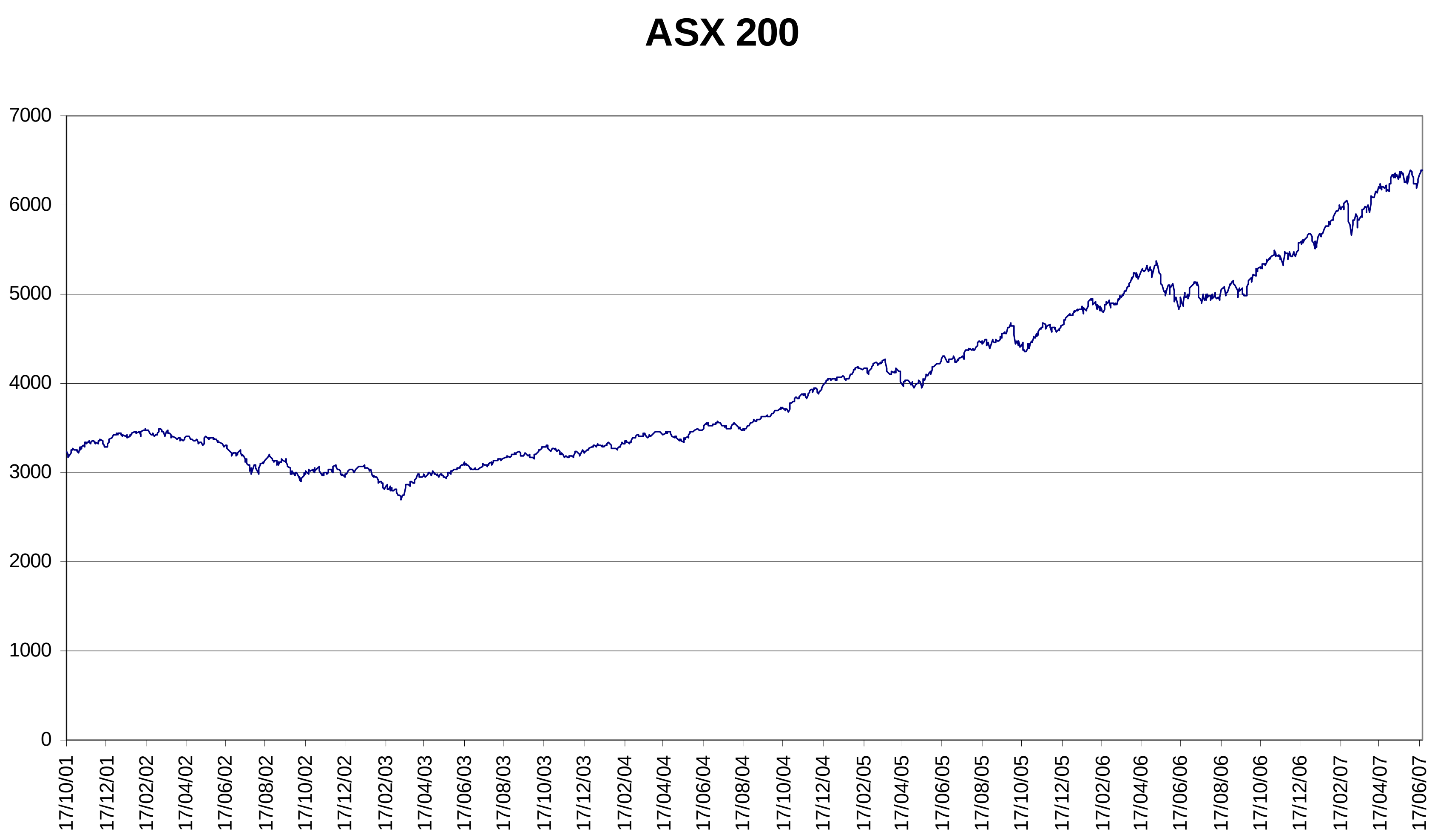
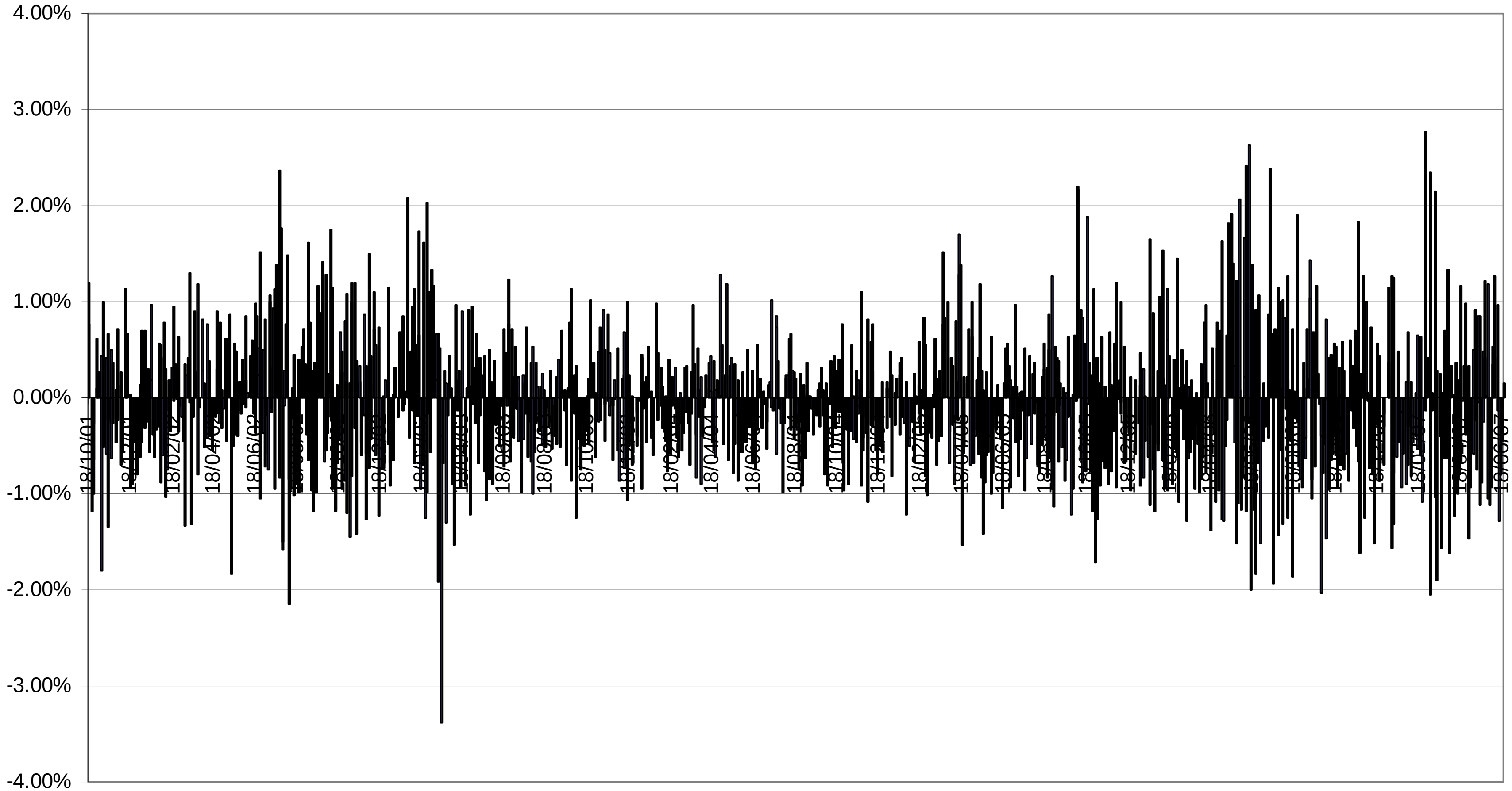
Is volatility constant?



Is volatility constant?

ASX 200 - % Daily movement



Modelling Volatility

- Many approaches to deal with non-constant volatility:
- ARCH family: Error term is heteroscedastic and auto-correlated, allowing “runs” of high and low volatility
- Ornstein-Uhlenbeck: Model volatility as a mean reverting stochastic process
- Markov regime switching: Model economy as having states with varying volatility characteristics. Transition matrices govern movements between states

A Topical Problem – Implied Volatility

- Reverse Mortgages incorporate the No Negative- Equity Guarantee – an embedded put option for the borrower
- Our risky assets here are:
  - The value of the Property
  - Short term interest rates (if loan is variable rate)
- Valuing this put option require a property model
- How volatile is an individual house price?
- How does volatility differ between geographical areas?
- Some data available on mean house prices, but moving prices for an individual property not available
- One solution is to merge knowledge of volatility in mean price index and distribution of price around mean

Dynamic Decisions

- Stochastic programming allows us to incorporate contingent events within each simulation
- Some Examples:
  - Policyholder decisions: Lapses/renewals/new business/policy conversions related to economic conditions
  - Management decisions: Asset allocation, premium rates, closure to NB
- Modelling policyholder decisions means fully allowing for contingent risks
- Modelling management decisions means allowing for reasonably foreseeable action, usually to prevent insolvency or improve performance

Dynamic Decisions (contd)

- Some considerations:
- Contingent actions of policyholders need to have credible backing evidence
- Management decisions need to be based on business plans, contingency arrangements and best-practice
- Need to allow for any delays in action i.e. cure unlikely to be applied instantaneously

Market consistent valuations (MCV)

In essence, the concept is to place a value on liabilities in a manner which is consistent with how the market prices comparable financial instruments

What's a comparable instrument?

- MCV of an annuity requires the matching bonds
- MCV of a capital guaranteed bond requires the underlying asset plus a suitable put option

Comparable instrument or ‘replicating asset’ may not exist

Then we must use financial mathematics to derive or model a synthetic replication to come up with a MCV

Real world – realistic cashflows

Deflators are essentially stochastic discount functions

Traditional PV of cashflow = Vt E[Ct]

MCV PV of cashflow = E[Vt Ct]

Risk neutral – risk adjusted cashflows

- Adjusted ‘risk neutral’ probabilities
- Risk-free rate

Which method is best?

Both approaches will give the same value result

Really depends on the purpose of the valuation

Why bother with MCV?

- Being objective as calibrated by the market?
- Prevent any issues such as artificial value creation through changing the asset mix
- Produce a fair value of liabilities
- Place an appropriate value on options and guarantees

MCV AVs – the problem with new business

- Calibrate to market growth rates for life insurance business?

- This is more of an issue in situations where the value of future new business is significant. And this is often the case in the Australian market

MCV AVs – the problem with new business

- How the growth rate will vary with the market
- Traditional approach of a single RDR means that both the EV and new business have a value reduction

MCV AVs – the problem with new business

- Treatment of unsystematic risk means a new business risk adjustment is required to be applied to value new business

- Lower multipliers than a traditional approach?

MCV AVs – the problem with new business

The real solution lies in the ability to develop a stochastic growth rate with a distribution that is based on market data. This most likely means a different new business multiplier for each product type

Some areas for discussion?

- What’s the future role for stochastic techniques in Australia?
- How do we model MC growth rates?
- Would complete development of past correlations with the market adequate for proxy new business MCV?