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# Equity Release Modelling: Valuation and Risk Management

Harry Hibbert



# Key Messages

1

**Equity release mortgage market has grown significantly in recent years and is a significant area of focus for regulators.**

2

**Residential house price risk is the key risk driver for these products; there are significant data challenges for residential property modelling.**

3

**Expert judgment is difficult to avoid for modelling ERMs in a number of areas.**





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# 1. Key product features and industry challenges

# Equity Release Mortgages

- Growing market - significant area of focus for regulators and life insurers

PRA warns insurers over lending standards of equity release mortgages

*FT, April '18*

🏠 > Money > Banking > Mortgages

**Rates have fallen on equity release: check your needs to find the best deal**

**The Telegraph** *Jun '18*

**Equity release records broken as lending hits £3bn**

**FT ADVISER**

*Jan'18*



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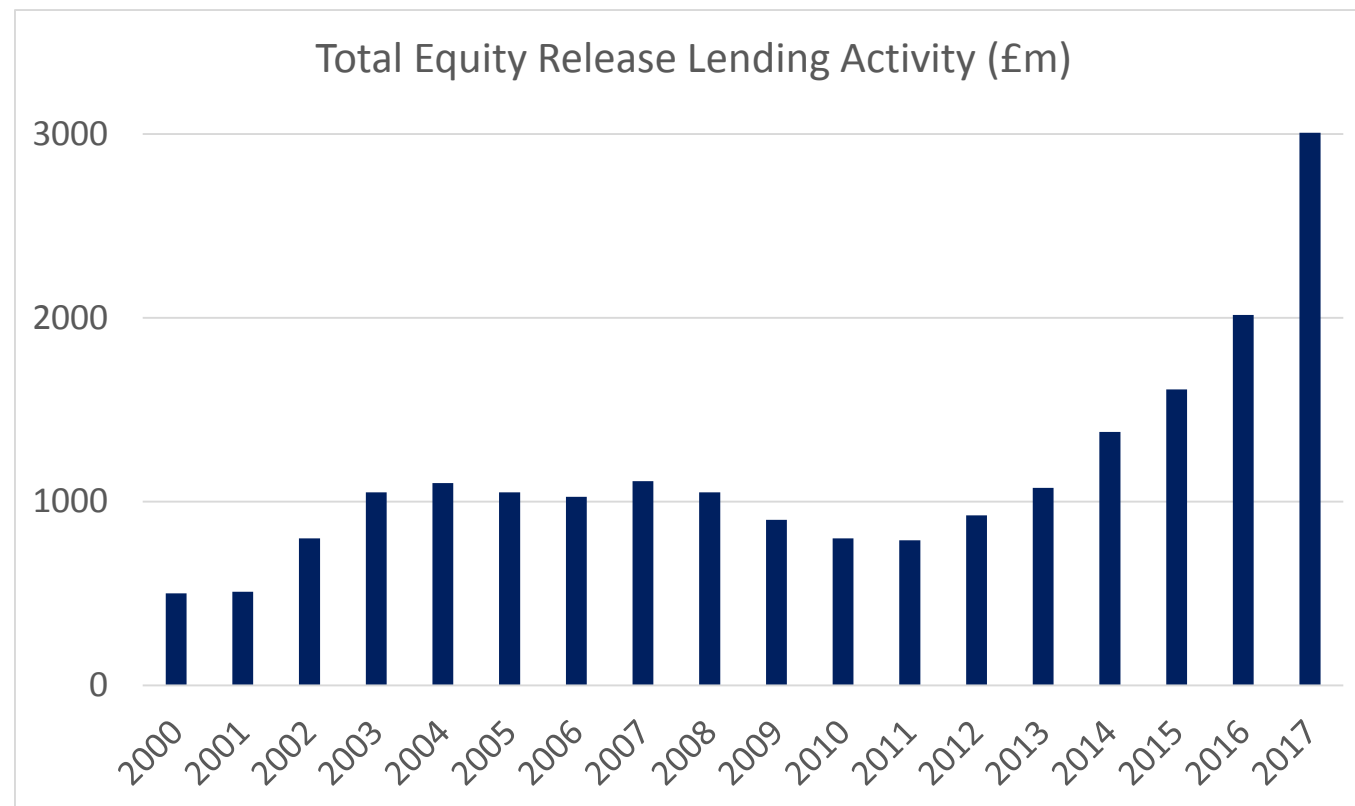
# Key Features of Equity Release Market

## Rapidly expanding market

- £4.6 trillion of property wealth in the UK
- Property viewed as very safe investment product
- Increasingly competitive and complex market (86 product types available Jan 18, compared to 69 in Jan 17)
- Voluntary repayment and drawdown facilities the most popular features (meaning new source of retirement income)

## Long duration ERMs provide good match for insurers' annuity liabilities

- Life insurance takes on most of the new equity release flow in the UK
- Key protection to customers or risk to providers is the “no negative equity guarantee”



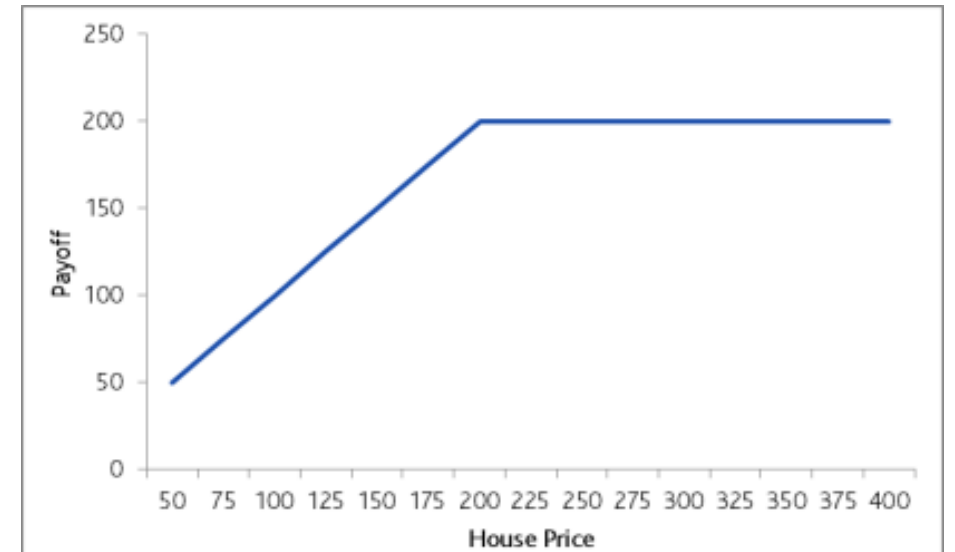
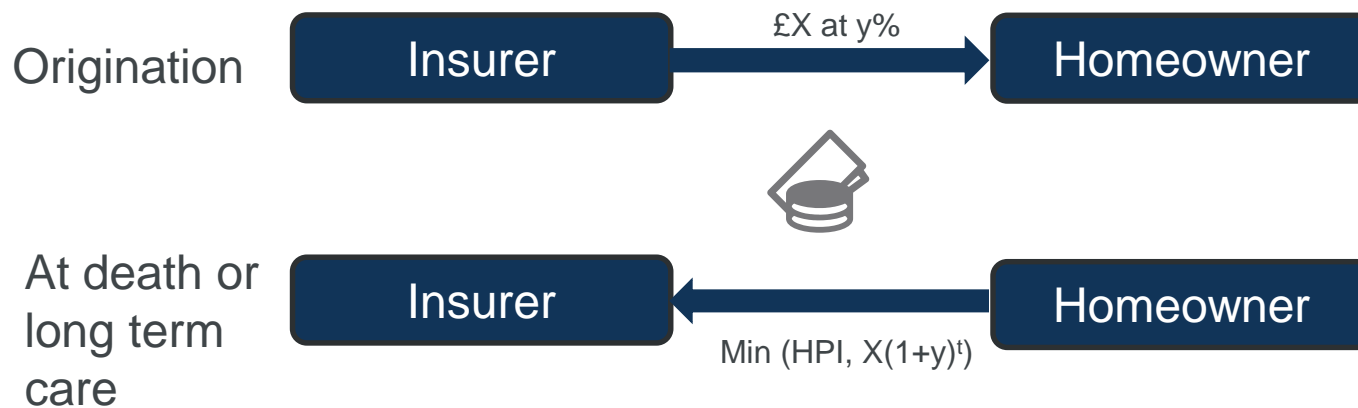
*Equity Release Council Data*



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# Equity Release Product

- Insurers lend money to homeowners with the house as collateral
- When the homeowner dies, the insurer recoups the principal + interest from the sale proceeds
- The equity release council rules state that insurer cannot claim more than the house price at sale (No Negative Equity Guarantee or NNEG)
- An equity release product is essentially a written put option on a house
- Payoff =  $\text{Min}(\text{House Price}, \text{Principal} + \text{Interest})$





# Risks in an Equity Release Product

## House Price Risk

Most significant economic risk.

Additional complexities for ERM products; they are written on individual houses rather than a portfolio of houses; results in further data challenges.



## Longevity

Uncertainty around duration of cashflows.

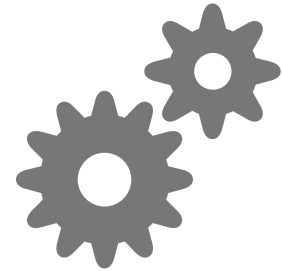
## Prepayment

Penalties?  
Links to economic factors?



# Prudential Regulation Authority Timeline

- ★ 2014 ○ In their current form, ERM *unlikely to qualify for matching adjustment* “...the PRA expects that firms will need to undertake restructuring or hedging actions to transform the cashflows...”
- ★ 2015 ○ Announcement to comprehensively review supervision around Equity Release Mortgages
- ★ 2016 ○ March discussion paper asking for industry views on valuation, risk management, restructuring, and other matters related to ERM.
- ★ 2017 ○ Publication of SS3 / 17 (after 21 month consulting period!) leading to tougher standards of valuation and emphasising governance standards for ERM products
- ★ 2018 ○ Following SS 3/17, planning an update to clarify expectations around valuation.





# SS 3/17 Key Points

- Sets out the PRA expectations in relation to illiquid, unrated assets within the MA portfolio
- Highlights PRA focus in two key areas; **1) internal credit rating methodology** assigned to equity release mortgages (and unrated illiquids generally) as well as **2) risk management of ERM**s
- Strong emphasis is also placed on senior stakeholder responsibilities in relation to these topics.

Supervisory Statement | SS3/17

## Solvency II: matching adjustment - illiquid unrated assets and equity release mortgages

July 2017



BANK OF ENGLAND  
PRUDENTIAL REGULATION  
AUTHORITY



*“The best estimate cost of the NNEG...is the mean of stochastic distribution of possible future guarantee costs, where the random variables used in the stochastic projection have been calibrated based on a best estimate of their true distributions.”*

# Key risk management challenges for Equity Release Modelling

Valuation is the present value of redemption cashflows minus the cost of providing the no negative equity guarantee (NNEG)

## How to value the NNEG?

- Closed form versus stochastic? (materiality and proportionality)
- Real world versus risk-neutral market consistent?
- *Significant challenge with developing appropriate key assumptions*

## Fundamental considerations

- Communication to senior / other stakeholders in the business
- Capability to stress the models and assumptions made
- Scenario testing





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# Technical Considerations for Modelling House Prices for ERM

27 July 2018

# Modelling House Prices

***“The most important risk factor is the long term impact on UK house prices...the risk of a long-term correction in UK house prices has increased as houses have become less affordable and rental yields have fallen”***

David Rule, April 2018, “An annuity is a very serious business”

## Key challenges

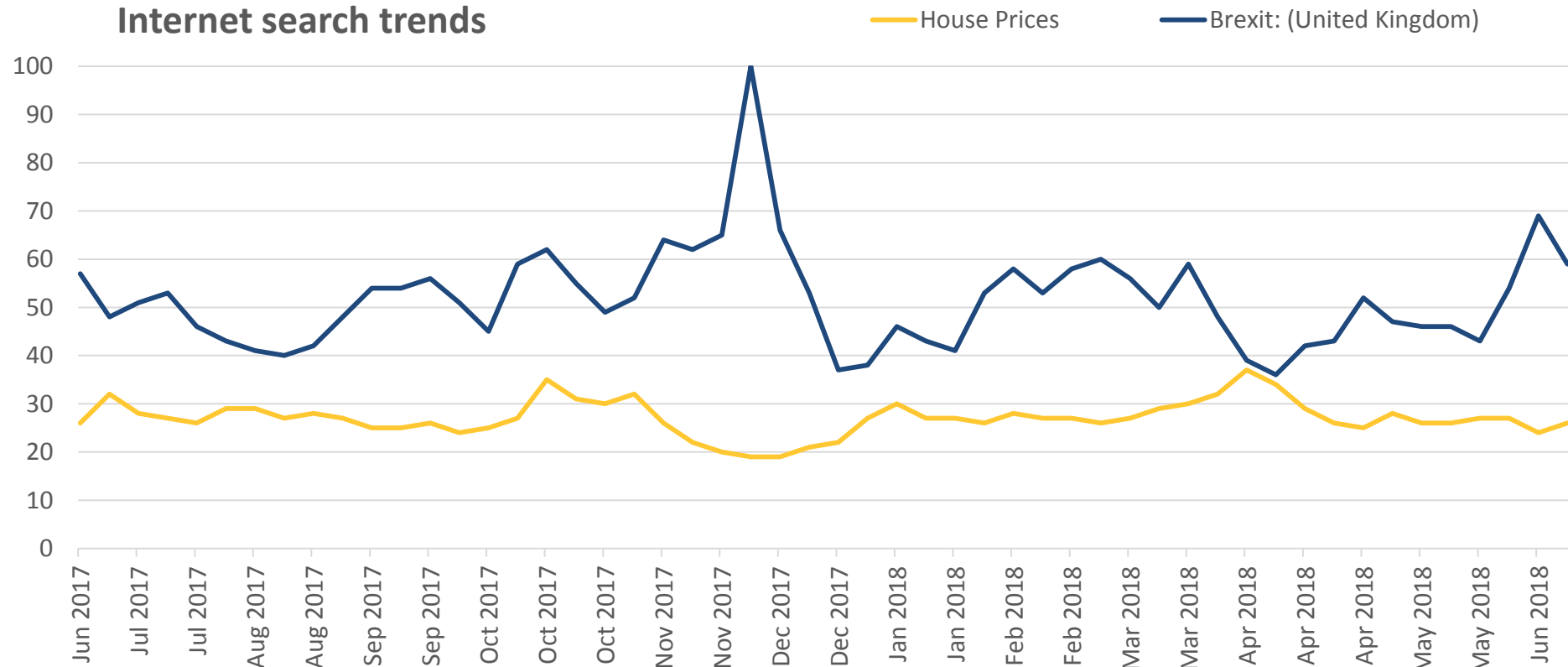
- **Data quality**
- **Model choice - extensive literature... but limited consensus**
- Do stylised features matter? (i.e. mean reversion and cyclicalilty)
- Value in running historical or other narrative scenarios?
- Expert judgement is unavoidable



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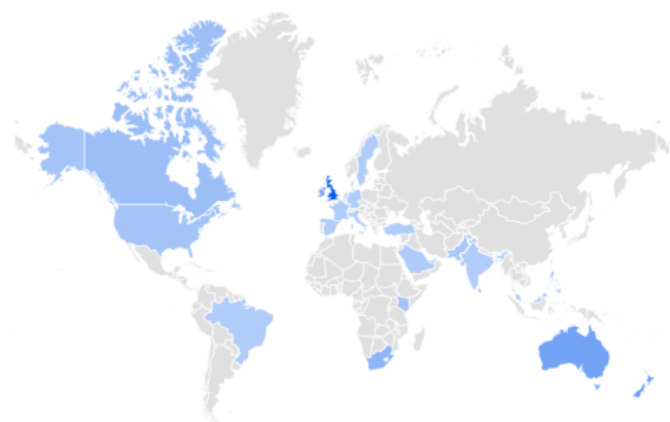


## Internet search trends



**House prices... everyone has an opinion!**

**...does that help and can it be modelled?**



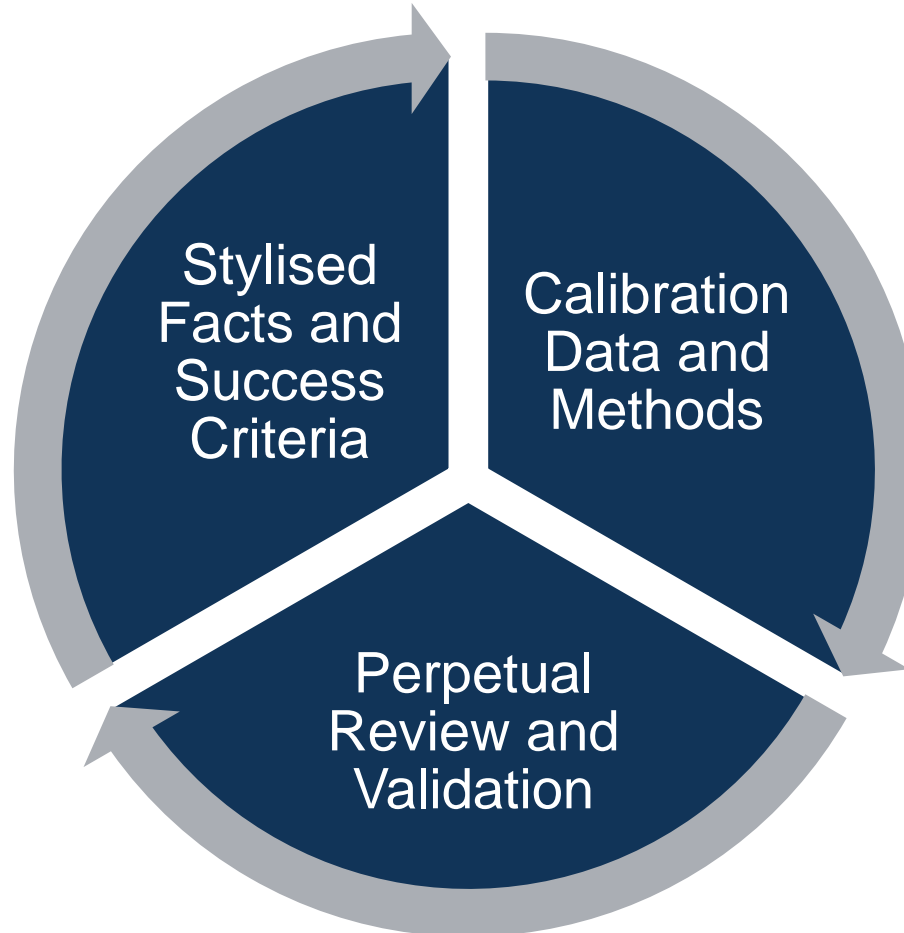
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2	New Zealand	40	<div></div>
3	Australia	36	<div></div>
4	St Helena	33	<div></div>
5	Ireland	33	<div></div>

\*data from Google

# General approach to modelling

Goal is to produce robust, modular solutions

- Supports model choice, development, validation, calibration, communication and understanding
- Appeal to academic research to develop priors, leverage data



- Clearly defined quantitative processes
- Governance framework
- Data quality
- Infrastructure



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# Data challenges for modelling house prices

Quality data is very difficult to find for property prices.

## Illiquidity / discontinuity in trading

- Many property price indices are based on appraisals by surveyors as opposed to realised transacted prices.
- Appraisals directly account for previously sold or nearby property prices. Can lead to serial correlation (**smoothing**) in returns based on this data.

## Heterogeneity (particularly relevant for UK residential)

- Usually results in sample selection or averaging in some way based on characteristics, measures which have the effect of directly smoothing out data.

**Serial correlation actually turns out to be a prominent feature of the data not just due to appraisal smoothing, but also related to the various methods for aggregating heterogeneous data (even if based directly on transaction prices).**

**The risk manager is concerned with price volatility, as well as price level.**





# House price index data

It is important to be aware of the methodology employed to build the house price index (or indices) being used in order to understand whether adjustments might be required.

Is the index transaction, mortgage or appraisal based?

How is heterogeneity being addressed in the aggregation?



## 1. Mix-adjustment method

- Stratify sample based on features, allows average prices of similar properties to be calculated, weighted average of the prices in the strata

## 2. Hedonic regression

- Estimate contributions of property features to price changes for sample by regression, then use the model to calculate price for the average house

## 3. Repeat sales regression

- Transaction based and uses identical properties



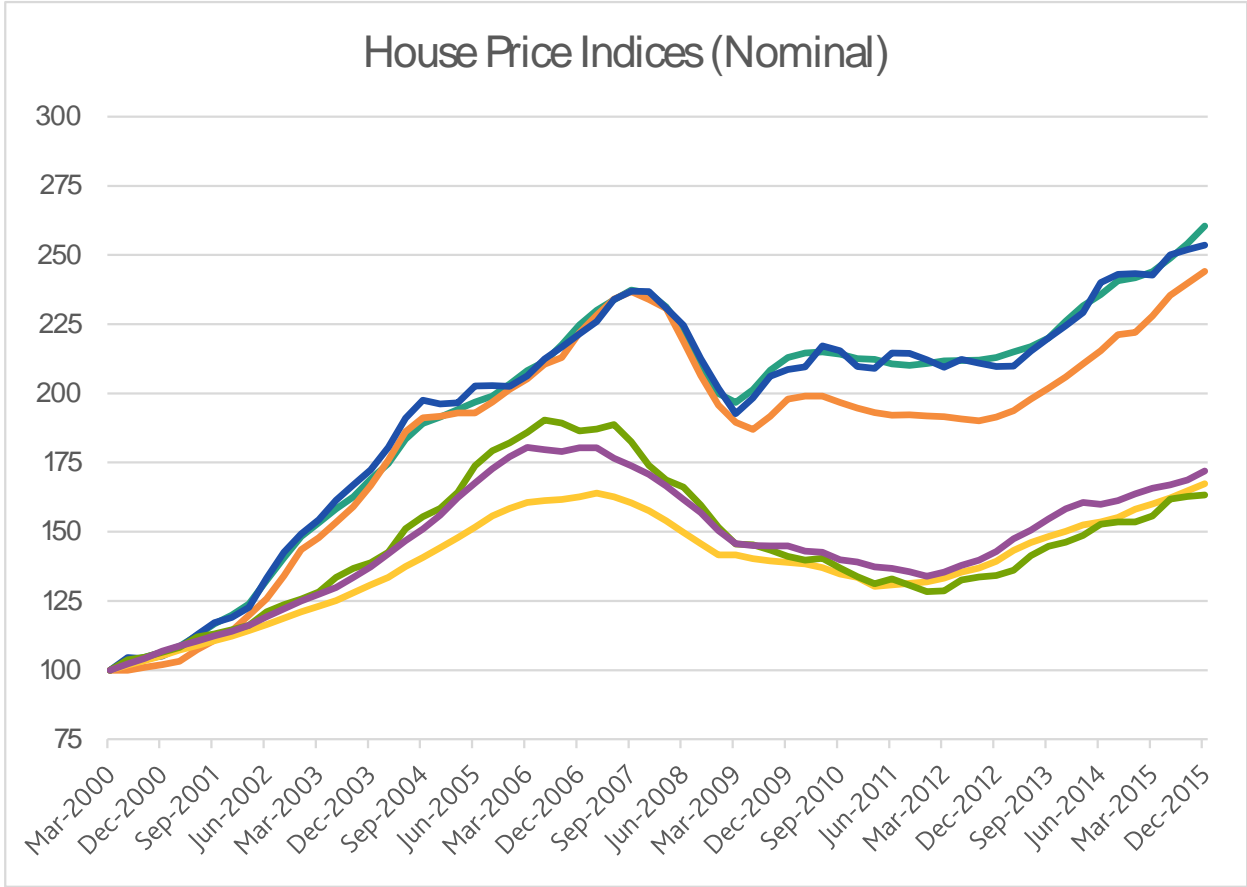
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# Selected Sources for House Price Data

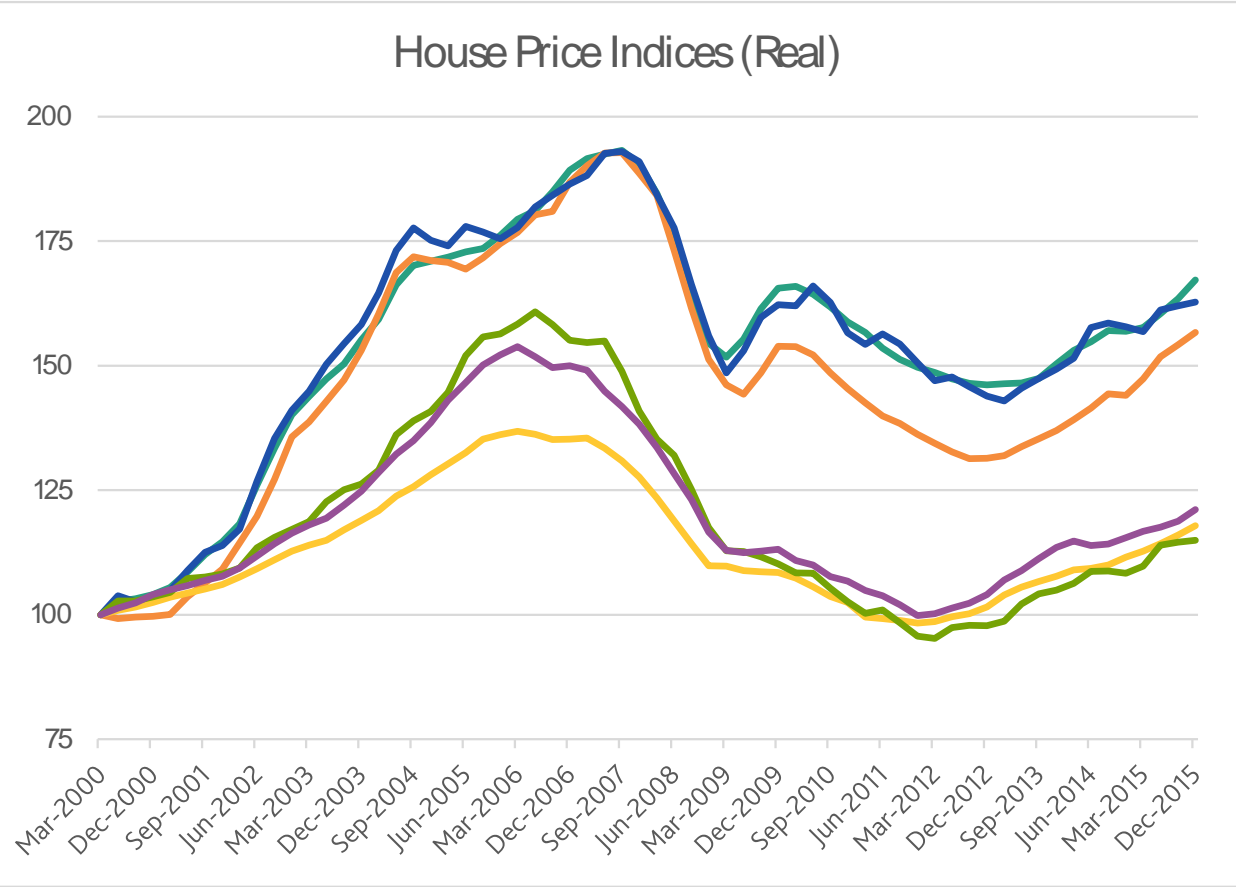
Country	Source	Data Adjustment Method	Frequency	Start Year
Australia	Australian Bureau of Statistics	Mix-Adjustment Method	Quarterly	1986
Canada	Teranet	Repeat Sales Regression	Monthly	1999
France	National Institute of Statistics and Economic Studies	Hedonic Regression	Quarterly	1996
Germany	Destatis	Hedonic Regression	Quarterly	2000
Hong Kong	Rating and Valuation Department	Mix-Adjustment Method	Monthly	1979
Japan	Ministry of Land, Infrastructure, Transport and Tourism	Hedonic Regression	Monthly	1998
Netherlands	StatLine	Sale Price Appraisal Ratio Method	Monthly	1995
Norway	Statistics Norway	Hedonic and Mix-Adjustment Techniques	Quarterly	1992
Sweden	Statistics Sweden	Sale Price Appraisal Ratio Method	Quarterly	1981
Switzerland	Swiss National Bank	Mix-Adjustment Method	Quarterly	1970
UK	Land Registry / ONS	Hedonic Regression and Mix Adjust	Monthly	1995
	Halifax	Hedonic Regression	Monthly	1983
	Nationwide	Hedonic Regression	Monthly	1973
	IPD	Capital Value Weighted Approach	Annual	1991
US	FHFA	Repeat Sales Regression	Monthly	1991
	FNC	Hedonic Regression	Monthly	2000
	Case-Shiller	Repeat Sales Regression	Monthly	1987

# US and UK Property Price Data

House Price Indices (Nominal)



House Price Indices (Real)



UK (Land Registry) UK (Halifax) UK (Nationwide)  
US (FHFA) US (FNC) US (Case-Shiller)



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# How should residential house prices be modelled?

## Key questions about the fundamental features of residential property prices – what are the stylised facts?

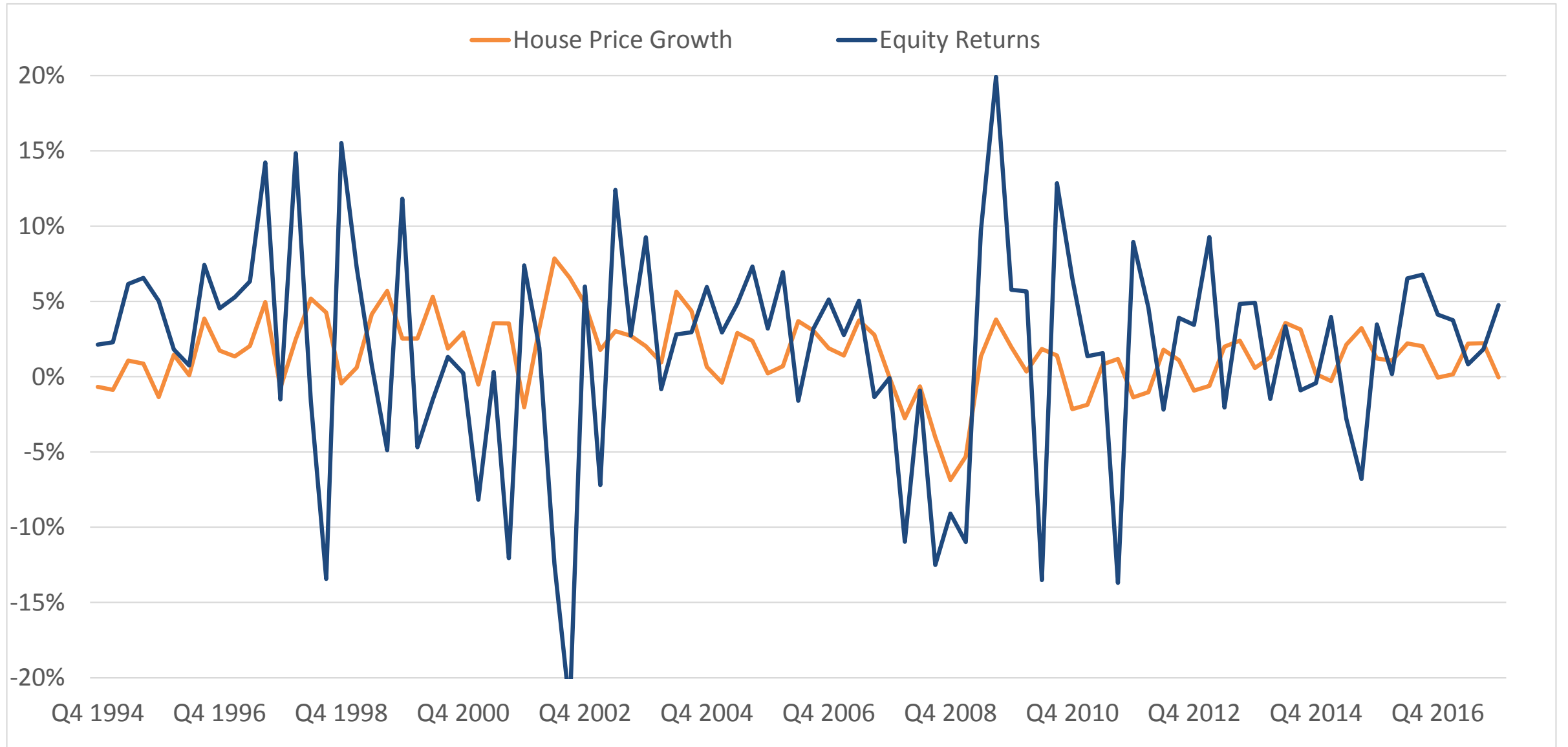
- Is residential property (in the UK) a special asset class? Or can we expect it to behave in a fundamentally consistent way with other investable assets?
- Mean reversion in price levels and price growth rates?
- Cyclicity and bubbles?
- What are the key macro-financial drivers of prices?

## Considerations for equity release valuation and risk modelling

- What can we expect the average house price growth rate to be?
- What is (the relevant) volatility?
- Can we expect regional diversification?

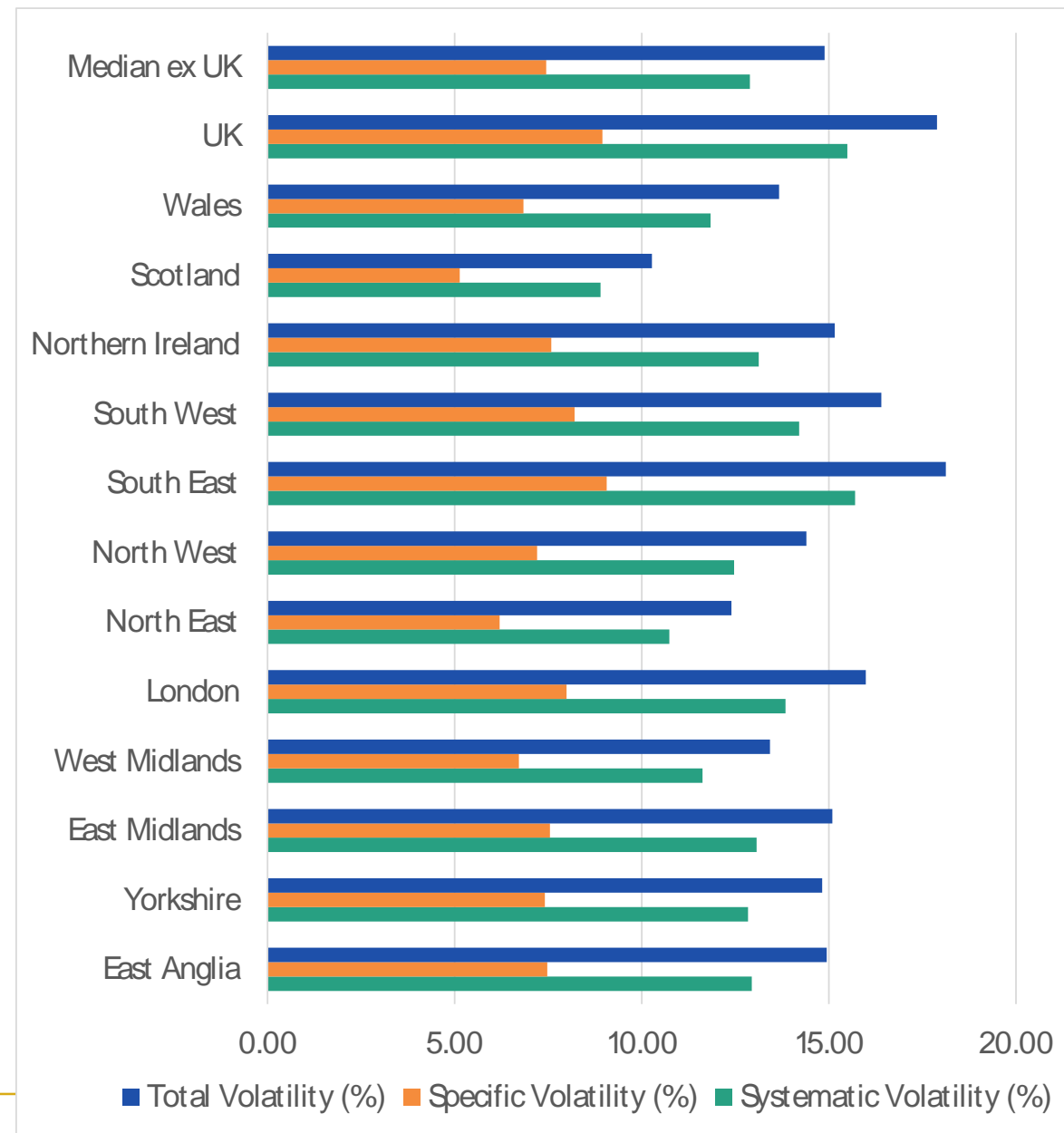


# Why do we care about 'smoothing'?



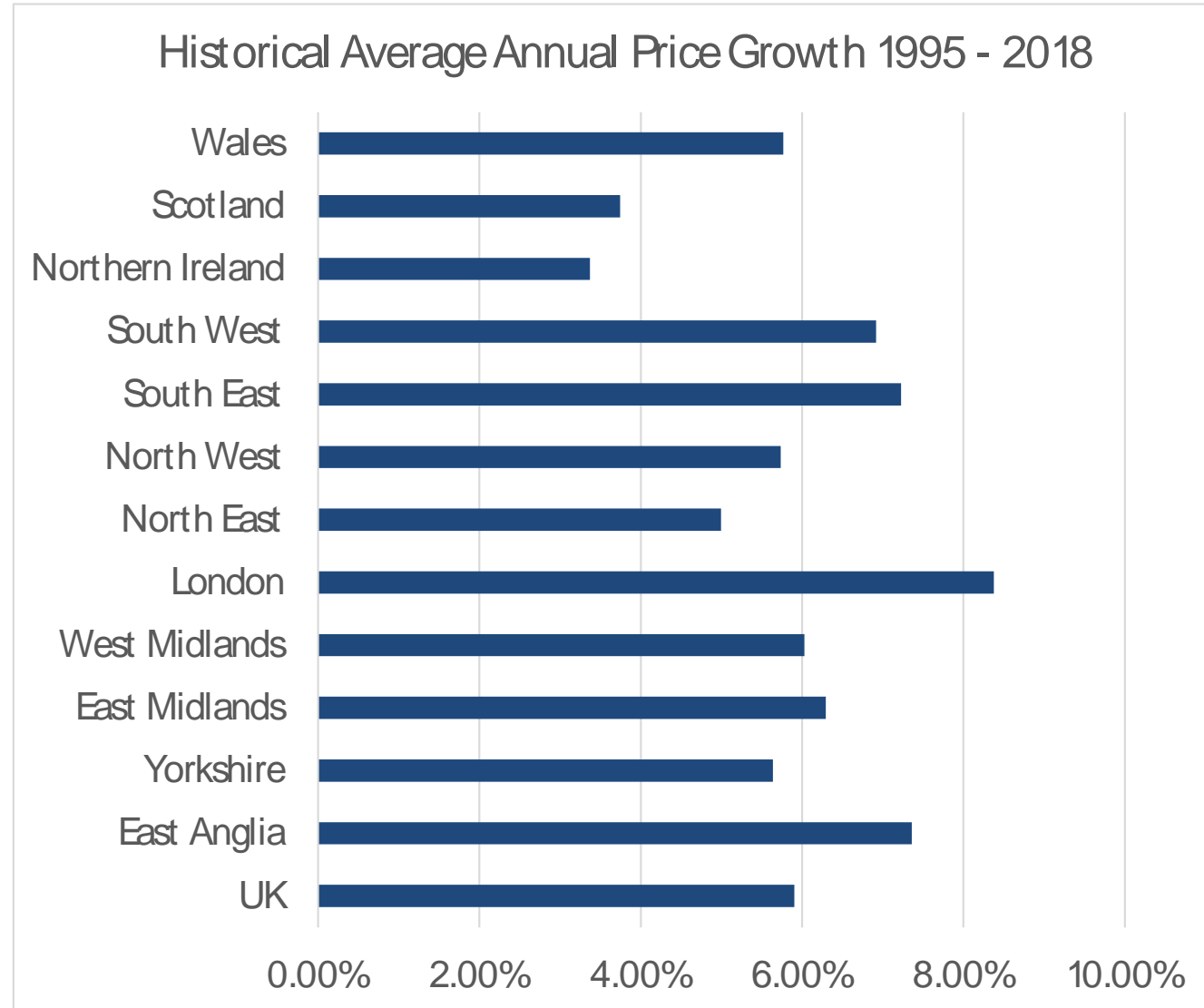
# Key Volatility Assumptions

- De-smooth data by removing serial correlation in order to proxy 'fundamental' price process.
- An equity release portfolio is a basket of options on individual assets rather than an option on a basket of individual assets; aggregated property index data could underestimate the risk associated with a single property.
- Serial correlation as a fundamental feature can be modelled, and has been investigated in the literature (Malpezzi 1999, Capozza et al. 2004) – but does it make sense for our purposes? And is there a benefit in modelling the 'equivalent liquid' process?



# Average growth rate assumptions

- Historical data may offer limited insight into assumptions appropriate for future price growth
  - The importance of regimes, population, taxes, monetary policy and other fundamental drivers
- **It is difficult to avoid expert judgment in developing an average price growth assumption**
  - Therefore, clarity around the decision making framework is important





# Average growth rate assumption framework

## Two perspectives

- **‘Macroeconomic’**: real asset with associated depreciation costs, consumer investment good – how can growth rates reasonably be expected to evolve in relation to inflation and interest rates?

$$\Delta p_t = \pi_t + RealPremium$$

- Other fundamental questions – how will house prices grow in relation to income? How will and can affordability evolve? (see Miles and Sefton 2018)
- **‘Investment’**: total returns, risk premia, rental yields, depreciation assumptions – what do these mean for capital (i.e. price) growth?

$$CapitalGrowth_t + Yield_t = i_{t-1} + \mu$$

- Long term average price growth of around 4% seems appropriate from this approach to analysis



# Model choice

**Various justifiable options – mean reversion (i.e. smoothing) are features which could be argued to be important.**

Simplified approach could use log normal (Black Scholes) style model for the unobservable, liquid component of property price growth.

$$\Delta p_t = \left[ i_t + \mu - \frac{1}{2} \left( \sum_i^n \beta_i^2 \sigma_i^2 + \sigma_s^2 \right) \right] dt + \sum_i^n \beta_i \sigma_i dZ_i + \sigma_s dZ_s$$

- Factor model enables modelling of correlation and split of systematic and specific risk
- Volatilities calibrated to desmoothed data

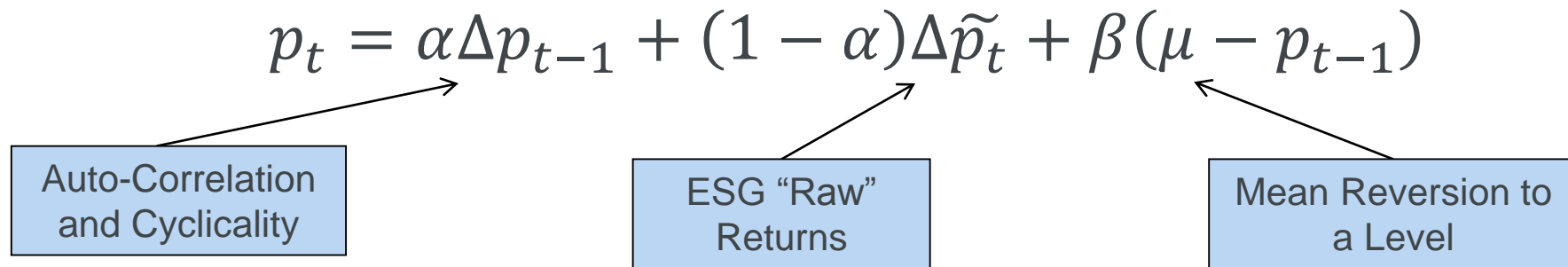


# Understanding the impact of alternative assumptions

Numerous possible models can be justified, it can be helpful to assess different stylized features

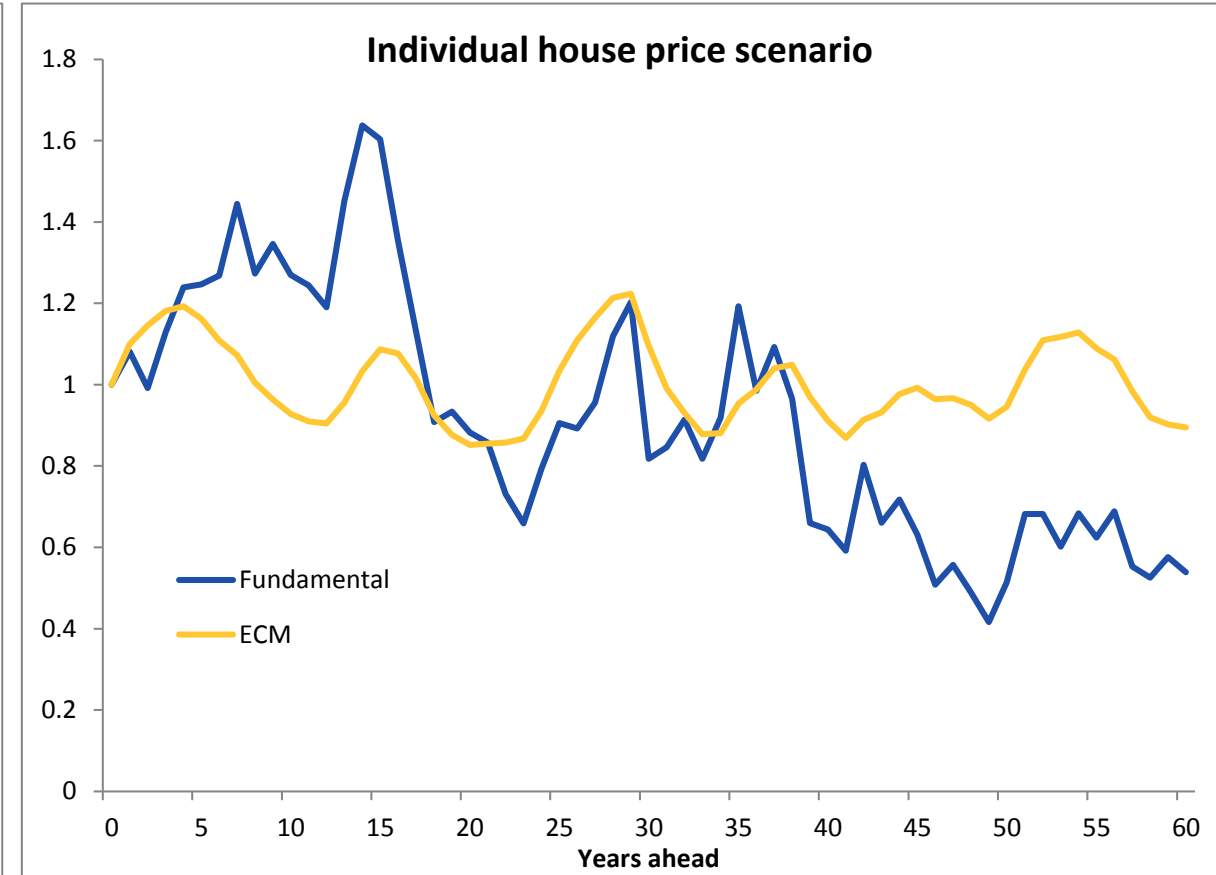
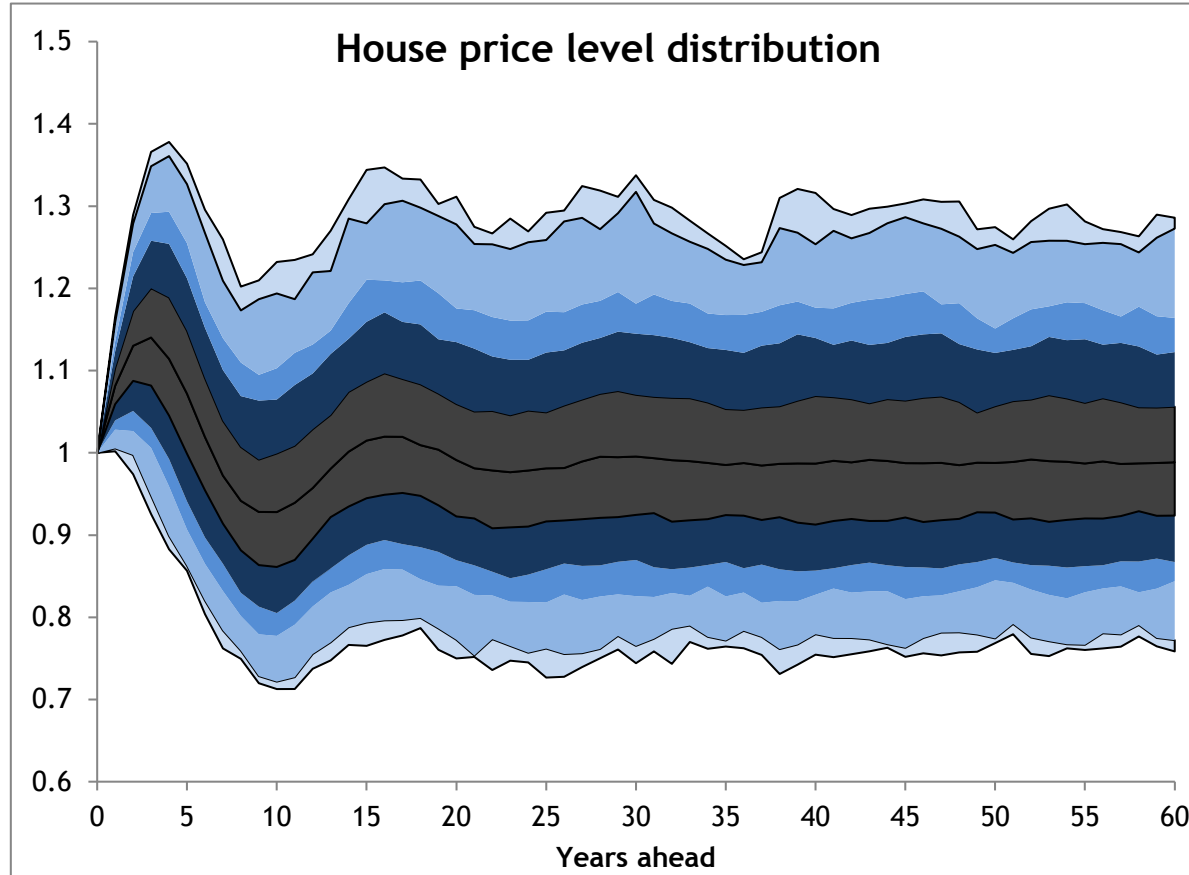
- Various internal stakeholders will have views
- This is significant expertise that needs to be clearly incorporated into the methodology and final method

## Error Correlation Model (ECM)



- Interesting and important to investigate the impact of these features on valuations.
- Even if they are not viewed as meaningful features of the data, academic debate in this area motivates the analysis.

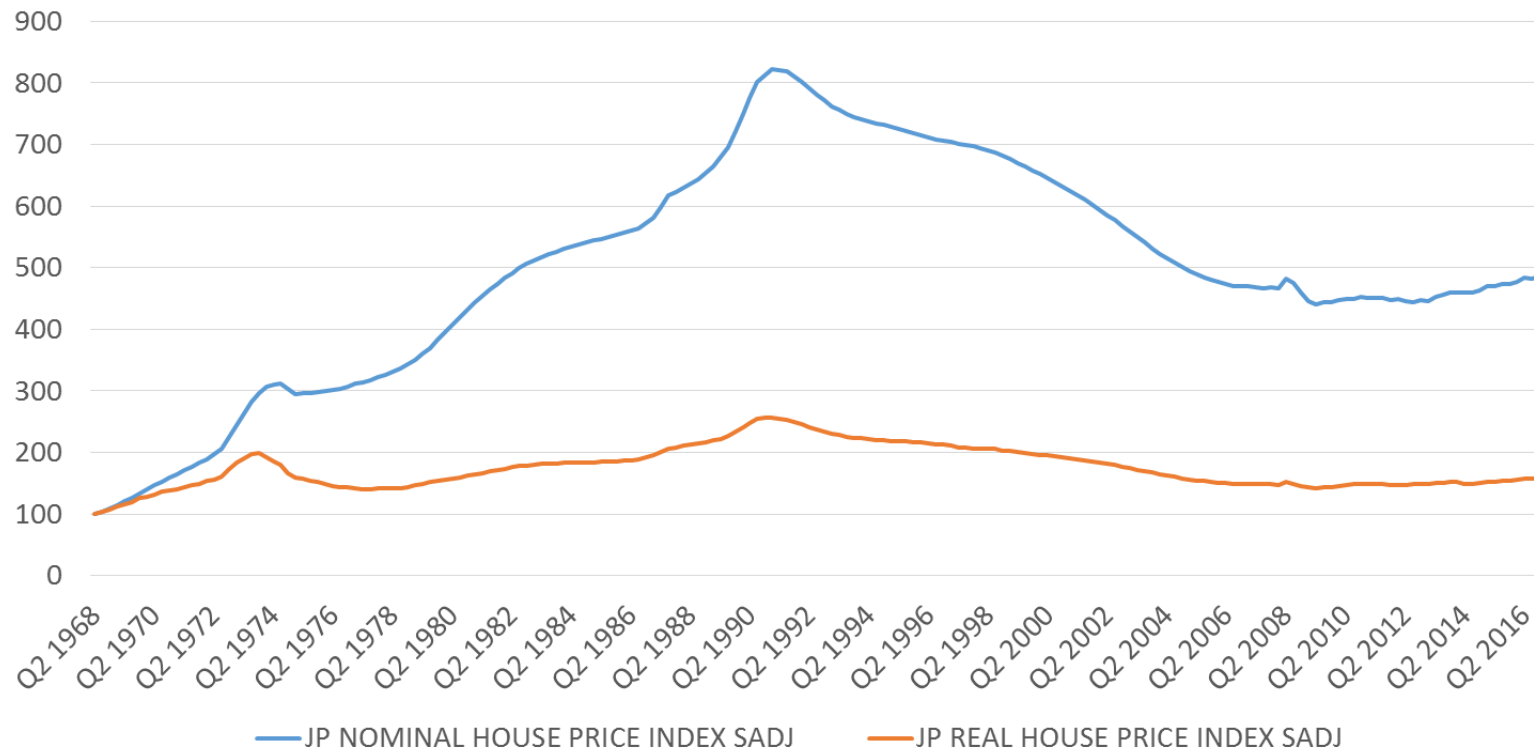
# Understanding alternative assumptions



# Narrative scenario testing

A complementary approach to understanding risks in ERM is to run narrative economic scenarios

- What happens if unemployment increases? What sort of income and house price growth rates could we expect after Brexit? Is a Japan-like scenario possible?



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**Expert judgment is difficult to avoid for modelling ERMs in a number of areas.**



# Questions

# Comments

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