Economic Forecasting - Why nobody knows anything.

"We love to predict things and we aren't very good at it." Nate Silver, *The Signal and the Noise*, p13.

Ron Smith
Birkbeck, University of London

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Outline

- My title comes from William Goldman, "Adventures in the Screen Trade".
  - Nobody knows anything..... Not one person in the entire motion picture field knows for a certainty what's going to work. Every time out it's a guess and, if you're lucky, an educated one.
- Material lifted from my MSc Forecasting lectures at Birkbeck. We have part-time students some of them professional forecasters from whom I have learned a lot.
- A:Uncertainty
- B: Forecasting methods
- C: Questions for forecasters
- D: Advice and Excuses

I teach forecasting, but my advice to students is

- Modelling and thinking about the future is essential to make decisions
- But do not forecast
  - Unless someone pays you large amounts to do it.
  - Since people pay, it is still worth learning how to forecast.
  - The forecasts will be wrong; so learn how to respond to forecast failure;
- Consider alternatives to forecasting: such as scenario planning, hedging/insurance, contingency plans.
- Don't try to forecast which horse will win the race, be like bookmakers: try to make money whoever wins.
- Military Sayings
  - Failing to plan is planning to fail
  - No plan survives contact with the enemy
  - So you need plans B and C and D (unless plan B undermines credibility of plan A)

A: Uncertainty

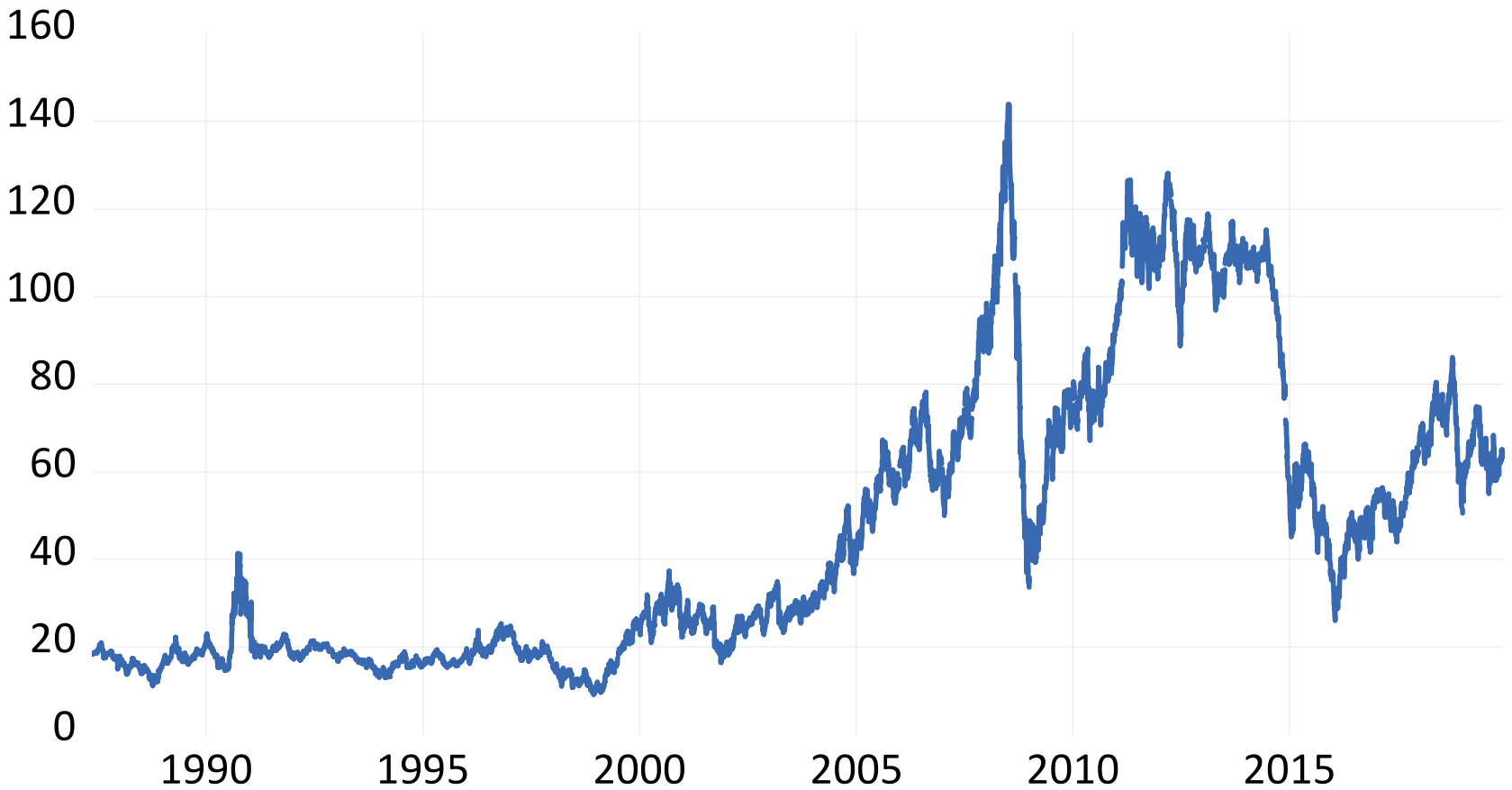
- Forecasting is common in any activity where decision making under uncertainty is important
- Some define
  - risk as where we know the event space, the set of possible events, and the probabilities attached to them;
  - uncertainty as where we know the event space but cannot attach probabilities to them; and
  - unawareness as where we do not know the set of possible events, where inconceivable events may occur, what Nassim Taleb labelled "Black Swans" or Donald Rumsfeld "unknown unknowns".
- We are primarily concerned with risk, which is more susceptible to statistical modelling.
- Lots of other definitions of risk, ISO31000: the effect of uncertainty on objectives. This can be positive as well as negative: death is certain, life is uncertain.

The oil price

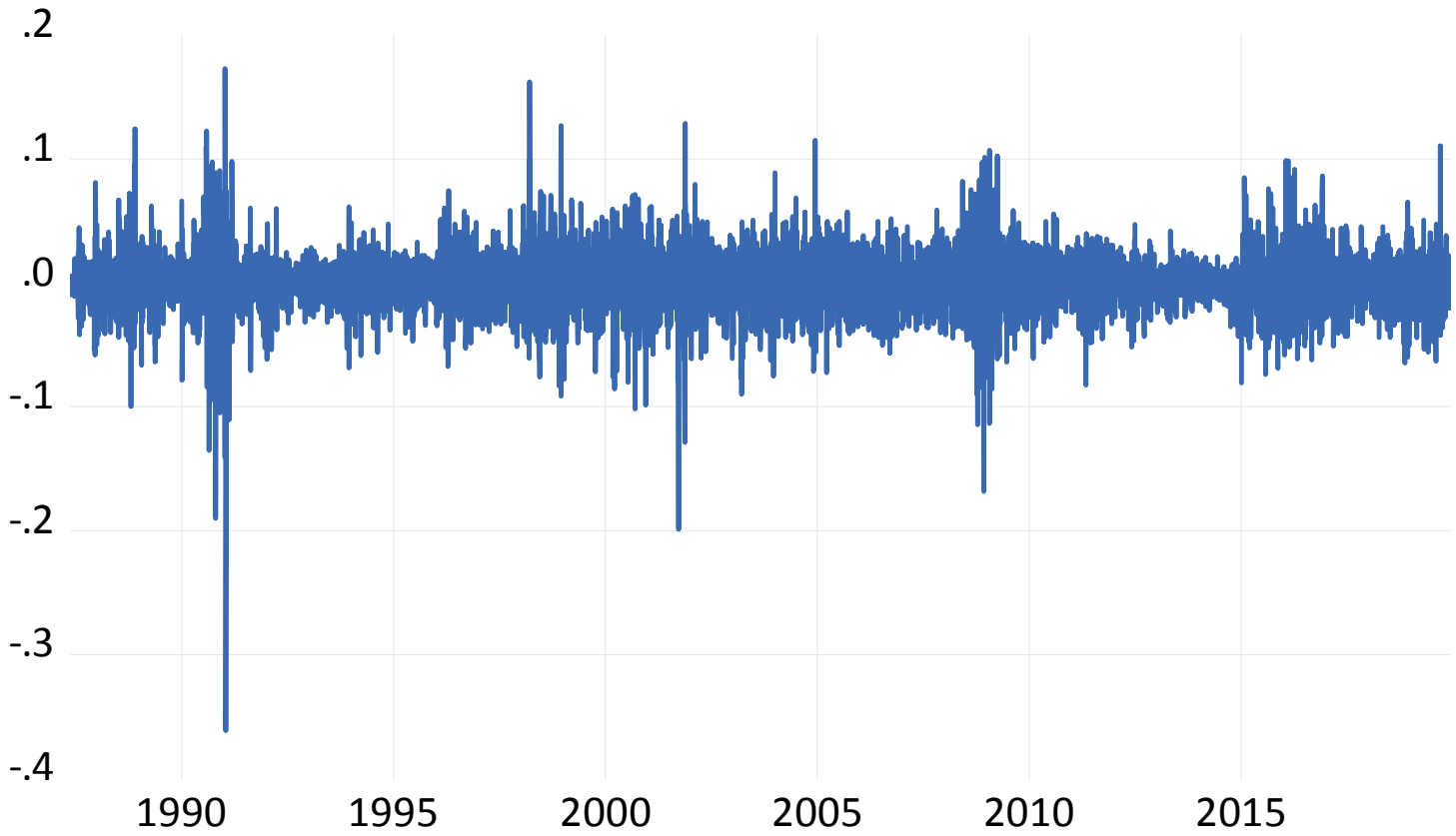
- The event space? We do not know what things that may influence the oil price over different horizons.
- My list in my January lecture was
  - Geopolitical factors: drone attacks on Saudi refineries; tensions in Saudi, Russia, Iran, Venuzuela, Nigeria,.....
  - Geological factors: reserves/discoveries, costs of exploiting them, ...
  - Logistic factors: inventories in Cushing Oklahoma, restrictions on tankers, blocking Gulf of Hormuz, ..
  - Demand factors: growth in China, US, ...
  - Technological factors: alternative fuel sources, ...
- I forgot pandemics. Not a black swan. Had been top of the government risk register.
- Financial markets love risk but hate uncertainty. How do they turn uncertainty into risk? Make it a random variable: price defined over a space.

Brent $/barrel daily (breaks weekends) 1987-2019

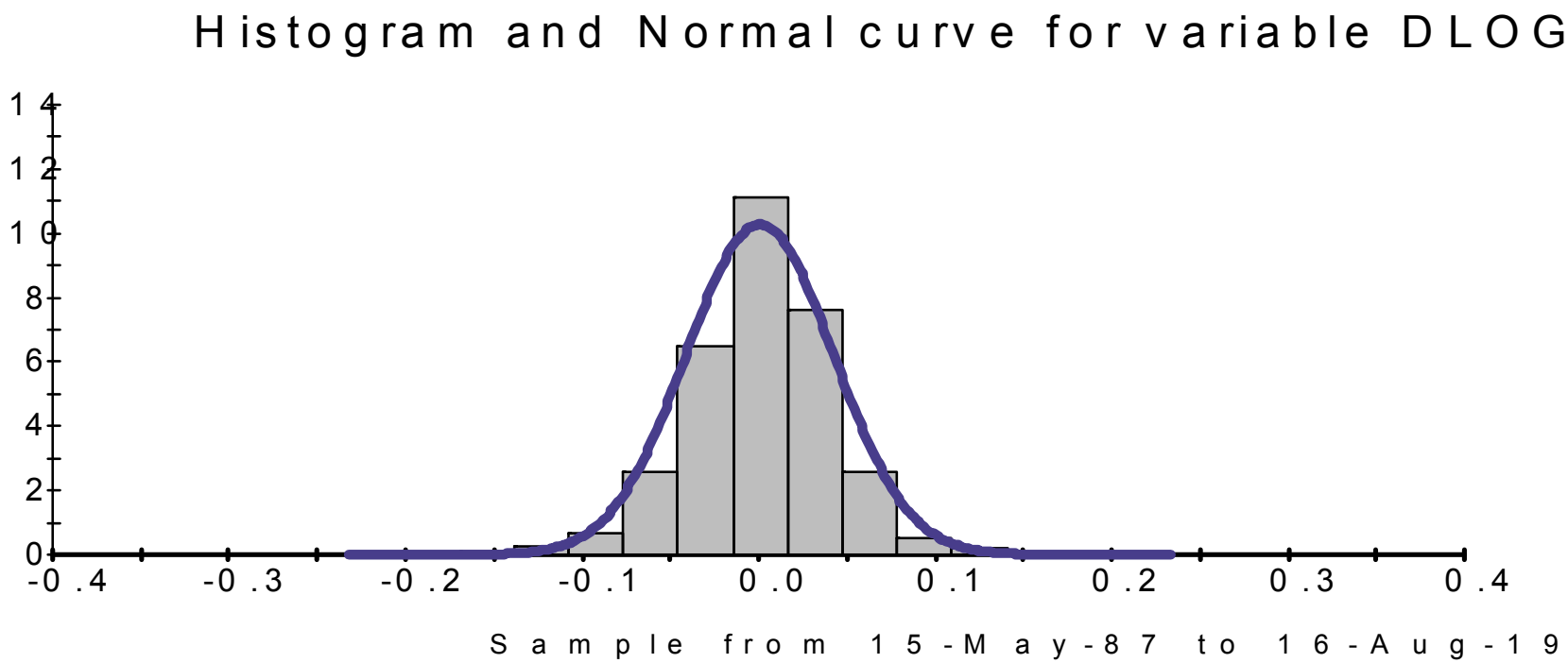
Very close to log random walk $\ln y_t = \alpha + \ln y_{t-1} + \varepsilon_t$



Change in log Brent: Looks nasty



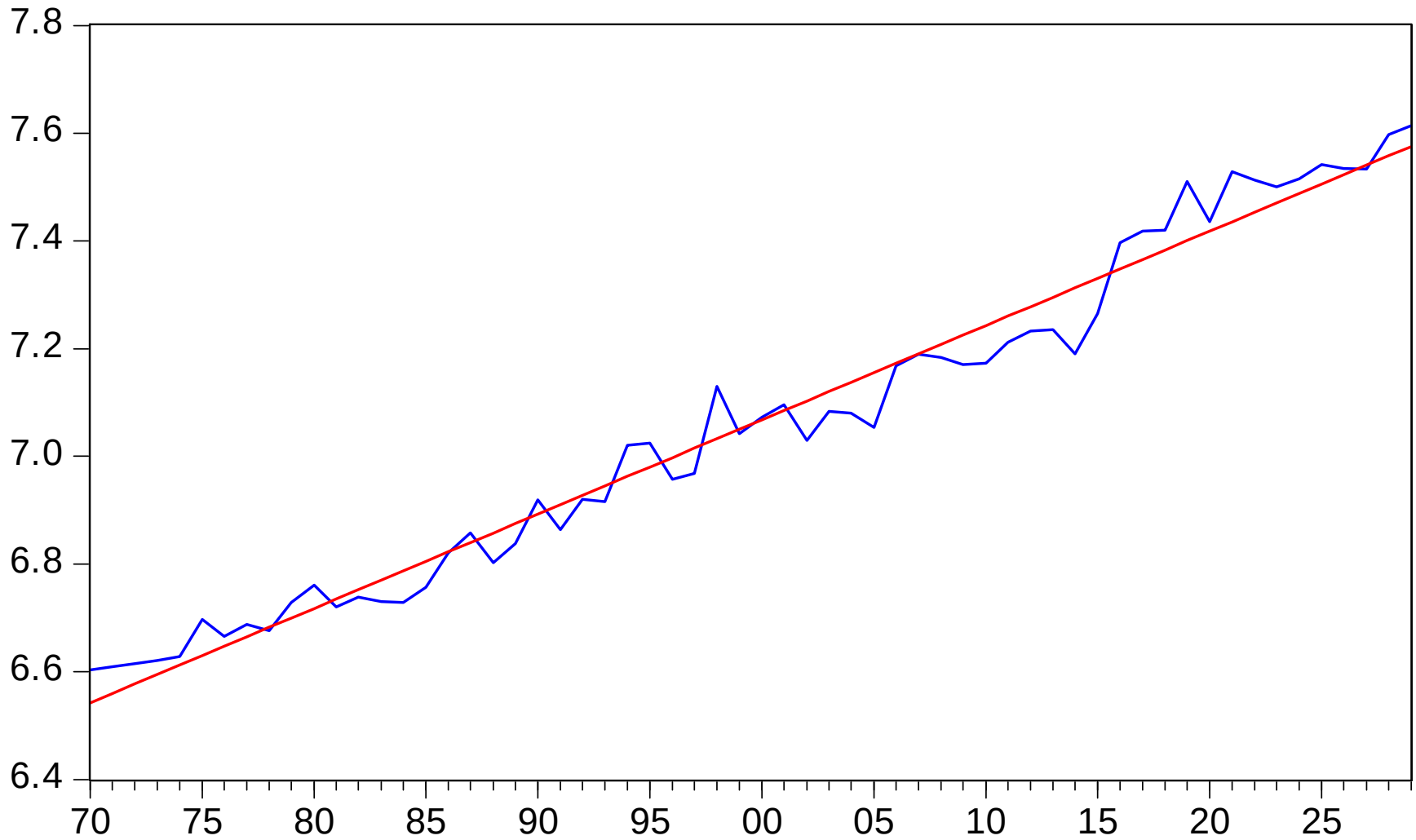
Distribution of change in log Brent, $f(y)$: range $\pm 23\%$ in a week: fat tails excess kurtosis,



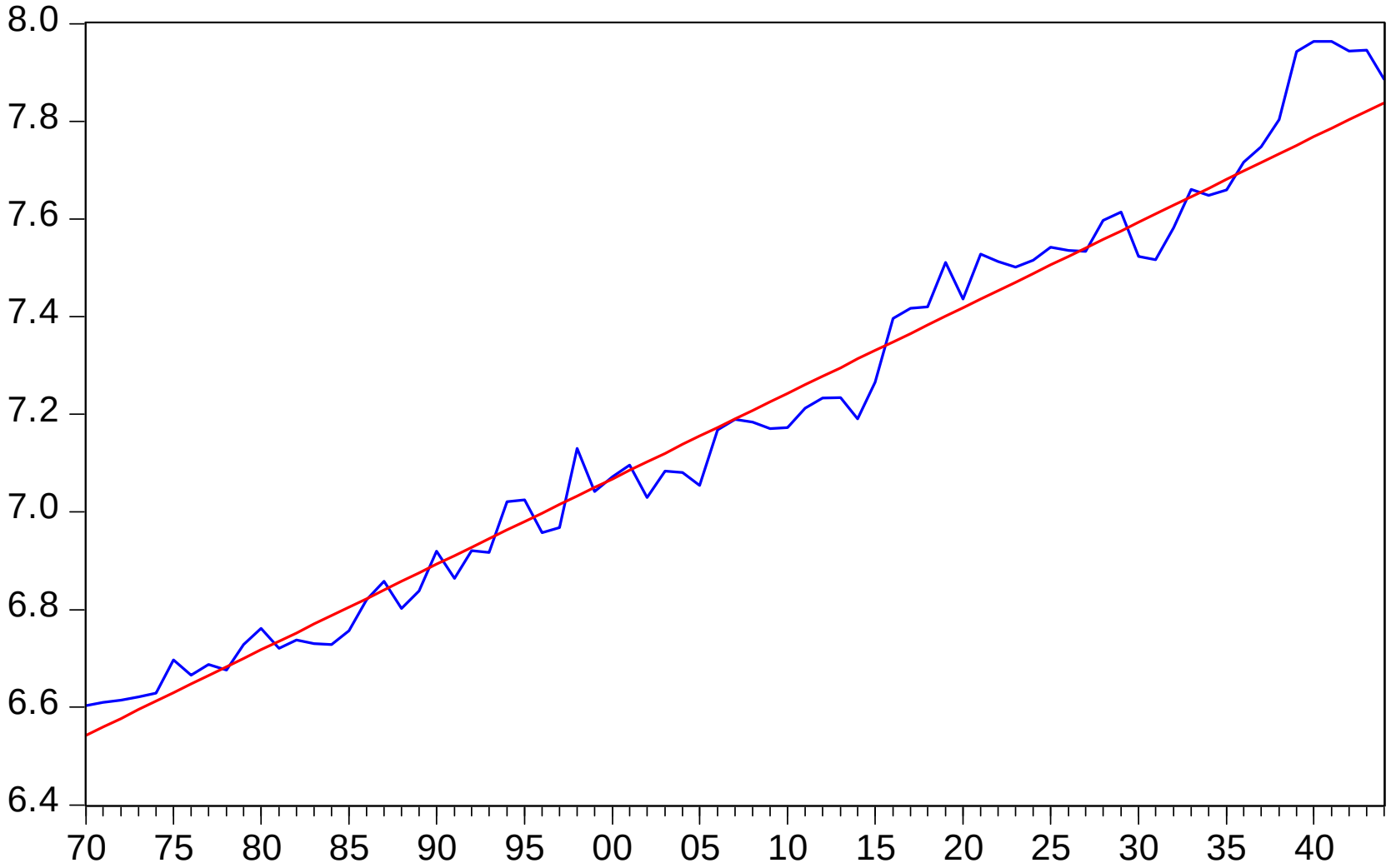
On Trends

- **Sir Alec Cairncross**
  - A trend is a trend is a trend.
  - But the question is will it bend?
  - Will it alter its course
  - through some unforeseen force
  - and come to a premature end?
- **A Variant**
  - A trend is a trend is a trend
  - So why should it alter or bend?
  - But the wise planner knows that the further it goes the nearer it is to the end.
- Below we estimate a linear trend on data for observations 70-129 Then see how it does as we extend the period

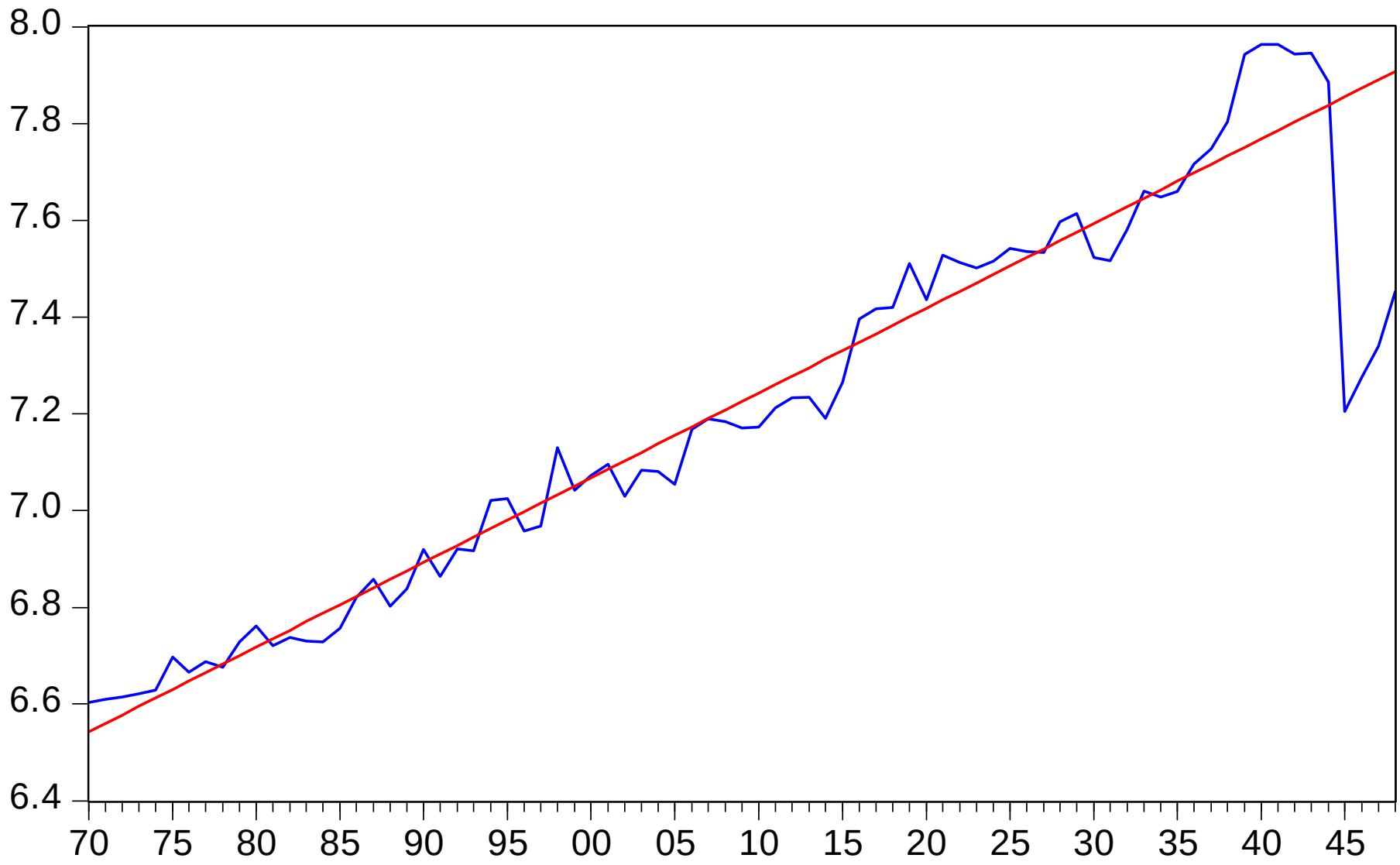
Observations 70-129 and fitted trend



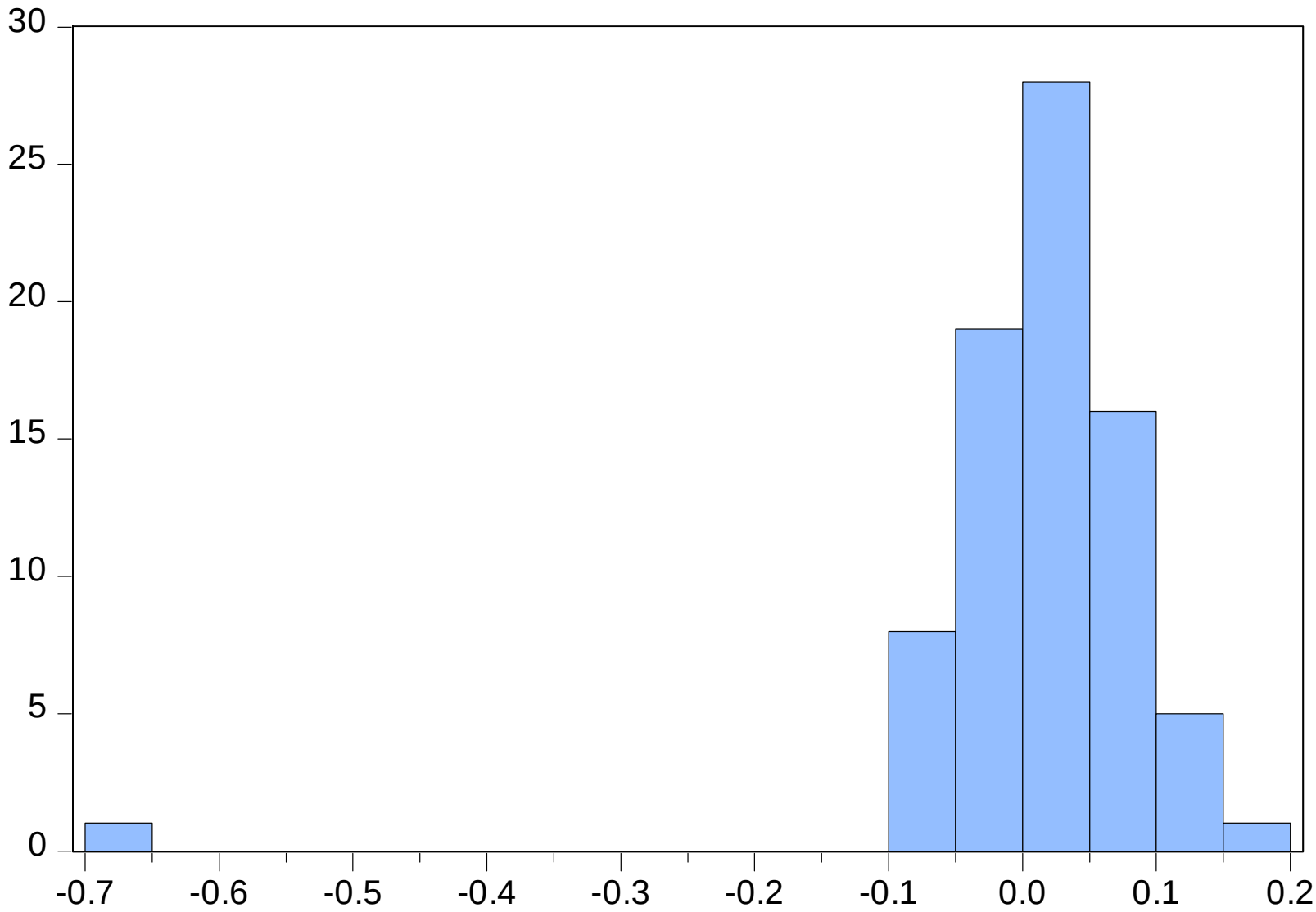
Observations 70-144 and 70-129 trend



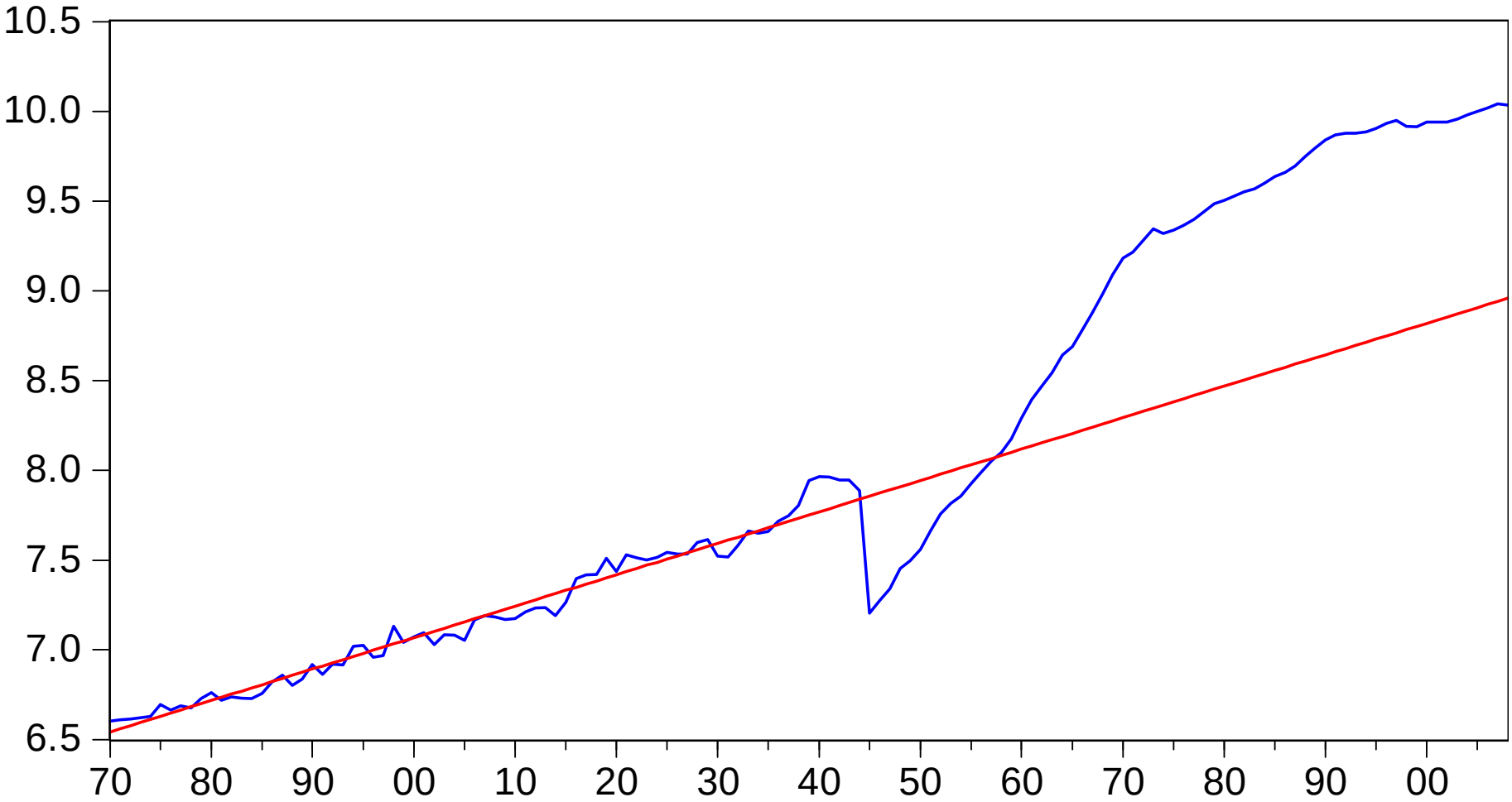
Observations 70-148



Tail risk: growth rate JB stat 4246



Japanese PC GDP 1870 2008 and 1870-1929 trend



B: Forecasting Methods

- Judgemental (guess)
- Surveys (ask someone else to guess)
- Technical (look at charts)
- Time series models:
  - univariate: trend extrapolation; exponential smoothing; ARIMA; structural unobserved component time-varying-parameter (Kalman Filter) models
  - Multivariate, VAR (not VaR), transfer functions
- Machine learning procedures like artificial neural networks .
- Econometric Models: more theory than time series and conditional on exogenous variables, e.g. policy assumptions.
- Will emphasise time-series and econometric methods.

Econometric Modelling in practice

- Assemble data (usually badly measured and out of date).
- Estimate equations, e.g. making endogenous variables a function of their lags and exogenous (e.g. policy) variables
- Get some software to run the model, hope it works
- Try to nowcast (guess) where you are now
- Starting from last forecast update beliefs on the basis of your previous forecast errors.
- Make assumptions about future values of exogenous variables, e.g. from market expectations of interest rates
- Run model forward to get initial forecasts
- Use judgement to add or subtract a bit to get forecast that you like and can tell a story about
- If a policy maker, experiment with alternative policy setting to determine least bad forecast outcome.

Models are useful

- Provide a Reproducible framework for systematic thought about alternative scenarios
- Act as a library for data and relationships
- Help you find out where you are now
- Impose consistency, make sure things add up
- Allow you to follow through complicated relationships
- Help you use judgement and other information in a coherent way
- Help you to ask clear questions, explain the answers, and provide a story
- Provide confidence intervals, densities and probabilities
- Allow you to learn from forecast evaluation
- Do it all quickly on a computer.

But you cannot rely on their forecasts: Why?

Forecasting is difficult, particularly about the future

- Efficient markets (prices are unpredictable version, not price is right version). This near unpredictability of many variables is one of the few empirical regularities in economics.
- Tails of the unexpected: Black Swans arrive in flocks.
- Non-stationarity/Structural Breaks: past may not be a guide to the future. Goodhart's Law: every well established econometric relationship breaks down as soon as it is used for policy.
- Economic forecasts are often conditional on assumed values for exogenous variables, e.g. government policy, which may change
- Feedbacks: system responds to forecasts
- Data very bad and out of date
- Sensitivity to initial conditions. The fact that we do not know where we are now can produce chaotic outcomes.

C: Diebold's six questions for forecasters

1. **Why are we doing it?** A good forecast is one that leads to good decisions, judge this by some **Loss Function.**
2. **What are we forecasting?** A time series, such as sales, or an event such as a recession.
3. **How to we wish to present our forecast?** Point, interval or density forecast?
4. **What is our Forecast Horizon? How far into the future do we wish to forecast?** This has implications for modelling strategy.
5. **What information do we use?**, Just the past history of the series? Other data?
6. **What method to use and how complex a model?** Parsimony (few estimated parameters) and shrinkage towards a prior may help.

1. Decision environment and loss function

- Forecasts are made in order to guide decisions and their value are thus judged on how they aid that decision in terms of minimising losses associated with a range of possible outcomes or states of the world.
- Often profit is the basis of the loss function not closely related to usual accuracy measures like Root Mean Square Forecast Error.
- Financial asset returns, often focus on direction of change forecasts: go long on the asset going up in price, short on the asset going down.
- Depending on your loss function biased forecasts are often optimal.
- The US government weather service makes unbiased forecasts of the probability of rain the next day. But the US TV Weather Channel makes biased forecasts? Why?

2. Forecast Object

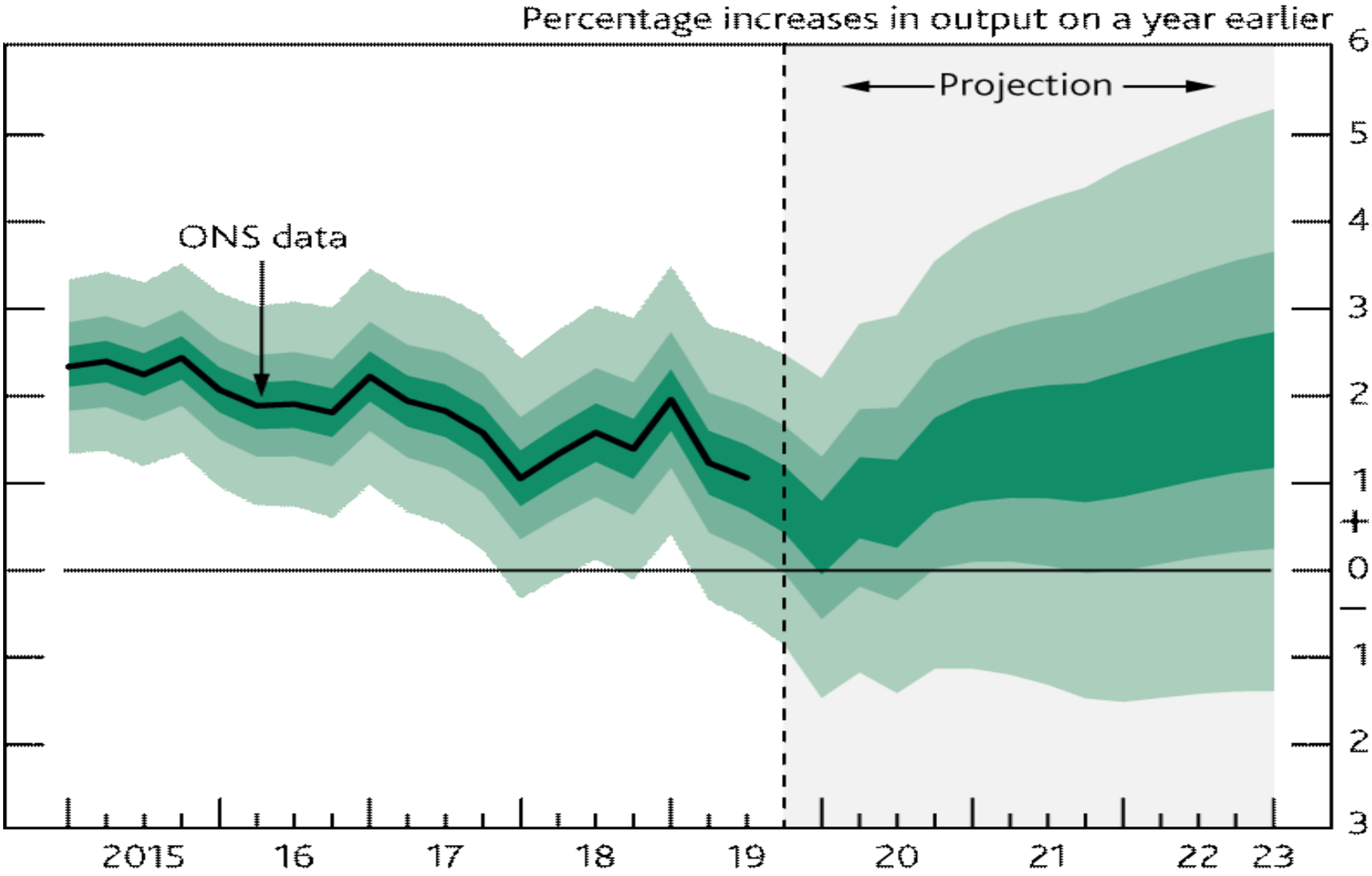
- Event Outcome; known event at known time with uncertain outcome: who will win an election, football match. Usually discrete.
- Event Timing. Known event at unknown time: e.g when will be the next recession.
- Event: will Iran test a bomb in a specified time? Superforecasters.
- Time Series forecasts: future value of a time series. Typical economic forecast. Usually continuous.

3. Types of Forecast Statement

- Discrete: It will rain tomorrow: $E_t(x_{t+1}) = \{1, 0\}$, for event x_{t+1}.
- Probability: 95% chance it will rain tomorrow. $P_t(x_{t+1} = 1)$. (Unfalsifiable on any particular day, like the typical English weather forecast: sunny with showers).
- Point: 10 mm of rain will fall tomorrow. $E_t(y_{t+1})$. For continuous random variable y_{t+1}. Single numbers are clear and simple.
- Interval: $P_t(a < y_{t+1} < b) = \alpha$. 95% chance that between 0 and 20 mm of rain will fall.
- Density: $f_t(y_{t+1})$. Probabilities of different amounts of rainfall tomorrow.

mm	$0-5$	$5-10$	$10-15$	$15-20$	>20
Pr	0.1	0.3	0.35	0.2	0.05

BofE Jan 2020 GDP growth Fan Chart, 90% bands: even in normal times nobody knows anything



4. Forecast Horizon h

- Number of periods (nano-seconds, days, months, quarters, depending on frequency) between when you make the forecast and the date of the forecast: talk in terms of h-step-ahead forecast.
- The appropriate length of horizon depends on the decision problem involved.
- **T**he Bank of England (2 year) OBR (5 year) MOD (10 year) have different horizons.
- The short term forecasting model may differ from the long term model, for the same variable.

5 Information set

- For horizon h the mathematical expectation for period $T + h$ based on information at T is written

$$E(y_{T+h} \mid \Im_T) \text{ or } E_T(y_{T+h})$$

- Information is costly, how much do you acquire. Non-traditional sources, e.g. satellite imagery, Google trends data.
- How big an estimation window? Bank of England has a Millenium of Data. How much of it do you use? Depends on how stable you believe the structure to be.
- Stationarity is central. If there are no structural breaks, forecasting is trivial: tomorrow will be like today. If there are structural breaks, forecasting is impossible: we have no basis to say what tomorrow will be like.
- Curse of dimensionality. Dangers of overfitting.

6. Method: Forecasters Folk Wisdom: simple models forecast best.

- Simple models with fewer parameters are more precisely estimated. Estimating parameters adds error.
- Random walk processes are common, so forecasting tomorrow will be the same as today often works well.
- Averaging forecasts and shrinking to a prior often helps: Bayesian VARs.
- Simple models easily interpreted and understood, makes them more useful in decision-making.
- Reduces the scope for data mining, over-fitting to the quirks of historical data, not relevant for the future.
- But simple model that forecasts well may be no use in policy making or story telling. It depends on purpose.

D: Advice. Tetlock's Ten Commandments

1. Triage: concentrate where the effort will pay off. Understand the decision problem.
2. Break problems into sub-problems.
3. Balance inside (problem specific) information and outside (base rate) information.
4. Balance under and over-reacting to the evidence.
5. Look at both sides of an argument. Think about the likely criticisms of your forecast.
6. Try and calculate the probabilities.
7. Balance under/over-confidence and prudence (analysis-paralysis) with decisiveness
8. Evaluate your past forecasts and learn from your mistakes and successes (were they luck?)
9. Learn from others

10 Practice

11. Don't treat commandments as commandments.

Comments

- Tetlock used Brier scores to evaluate probabilistic forecasts. There are methods to evluate density forecasts for continuous variables: e.g. Probability Integral Transforms: PITs.
- His superforecasters were responding to questions about specified events: Will Iran test a nuclear device in the next year? He recognises that somebody has to ask the right question.
- Greg Treverton distinguished between
  - puzzles, which can be answered by getting more information, and
  - mysteries, with no definitive answer because they depends on a future interaction of many factors known and unknown. Often with mysteries we have too much information.
- Only buy forecasts from forecasters who publish evaluations.
- Your forecasts are going to be wrong, what do you do?

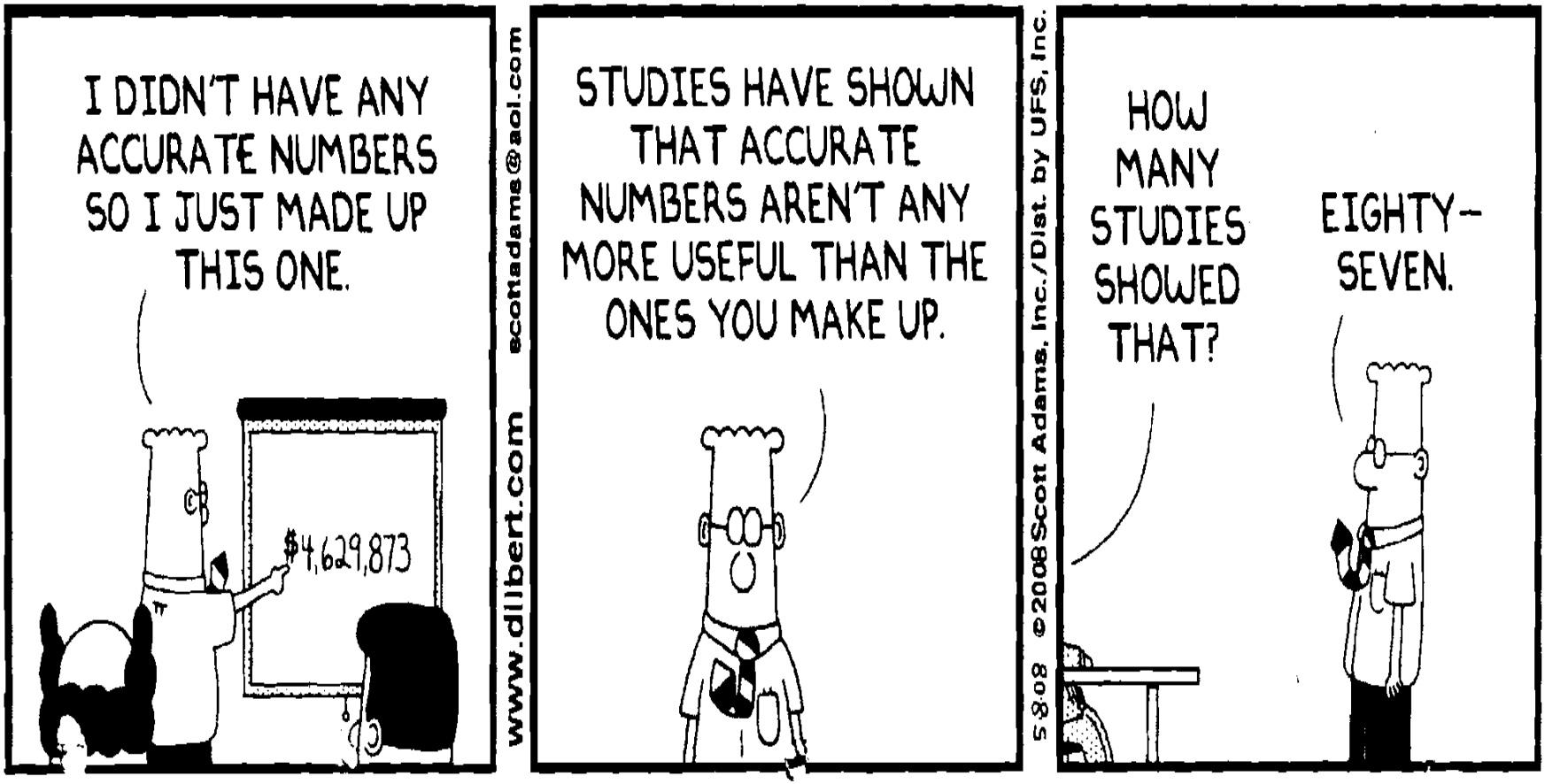
Responses to Forecast Evaluation I

1. Don't release forecast evaluations
2. Give the client a number or a date but never both
3. Have different forecasts in the text and tables, use the one closer to the outcome
4. Segment your clients and give different ones to each, some will think you're good
5. Use vague definitions like inflation, some inflation measure should be close to your forecast
6. Forecast large numbers of variables and focus on those you got right.
7. Explain why the evaluation is no longer relevant: the forecaster has been sacked and the model changed.

Responses to Forecast Evaluation II

8. Say the official data are wrong (they usually are).and your forecast is closer to the truth
9. Blame the exogenous variables, stupid government policy (if you are not the government), the weather (popular in retail), etc.
10. Say it was a self defeating forecast: government responded to your warnings and stopped the disaster you predicted happening.
11. Say errors are not statistically significant (confidence intervals are so large, they rarely are).
12. Say the forecast performance was very good using some other loss function.
13. Like the Bank in the May 2020 Monetary Policy Report, call it an illustrative scenario.
14. Keep close to the herd so you can say everybody else made the same mistake.

DILBERT / SCOTT ADAMS, scottadams@aol.com



Reading

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