A Graphical Model Approach to Simulating Economic Variables over Long Horizons

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Agenda

Background

- Graphical models are probabilistic models for which a graph expresses the conditional dependence structure between random variables.
- We use graphical models to simulate economic variables over long time horizons.
- We show that the approach we use is:
   - transparent
    - flexible
    - easy to implement

Agenda

Methodology - forecasting
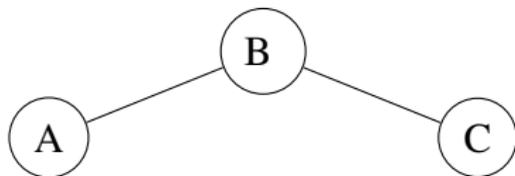
- Assume 3 economic variables A,B and C.
- The individual economic random variables, Z_{it}s, are modelled as:

  $Z_{it} = \mu_i + Y_{it}$, where $Y_{it} = \beta_i Y_{i(t-1)} + \varepsilon_{it}$ and $\varepsilon_{it} \sim N(0, \sigma_i^2)$.

- Correlation of the **error terms** is represented by a graphical model.
- The error terms:
  - ▶ are assumed to be independently distributed across time t;
  - ▶ which are directly connected to each other are dependent;
 - ▶ which are indirectly connected are still dependent, but more weakly so.

Methodology - selecting a correlation structure

- We use 3 algorithms to select a correlation structure, based on:
  - ► BIC
  - ► AIC
  - ► P-Values
- Hojsgaard et al. (2012). provide guidance on the use of packages written in R to estimate graphical models.
- We use the following UK economic time series data:
  - ► Price Inflation
  - ► Salary Inflation
  - ► Dividend Yield
  - ► Dividend Growth
  - ► Consols Yield

Structure using P-Values
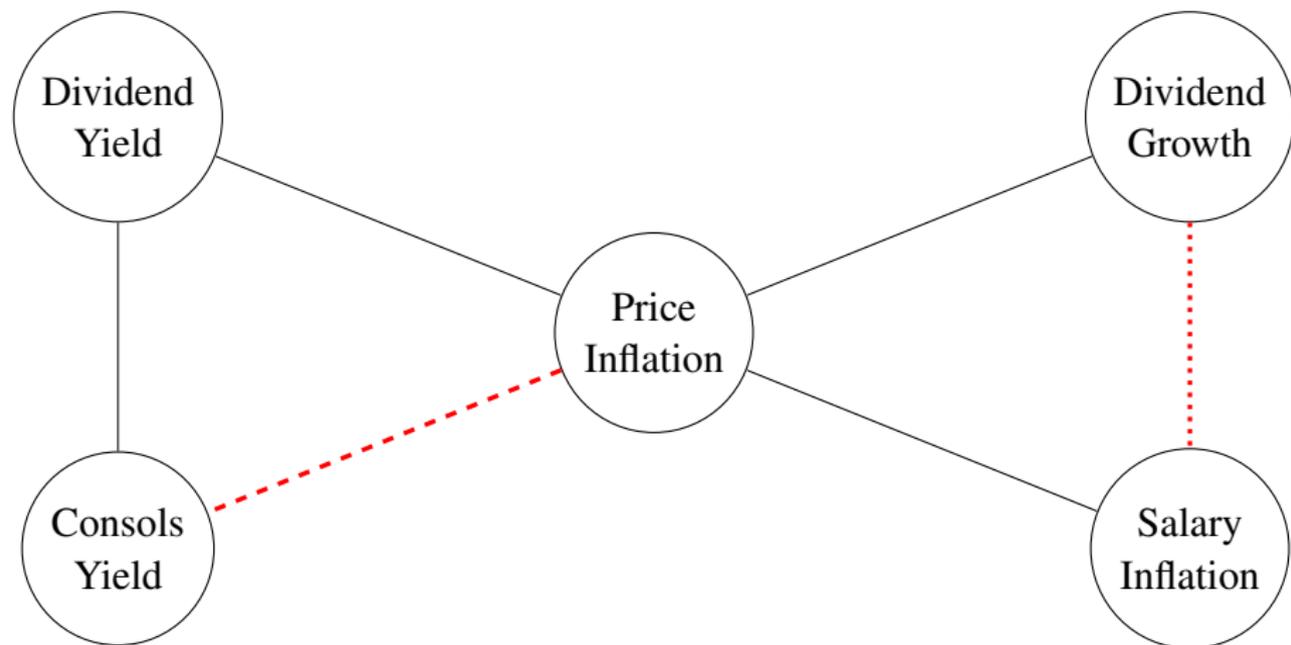
Graphical model with 6 edges

Agenda

Forecasts

Dividend Growth
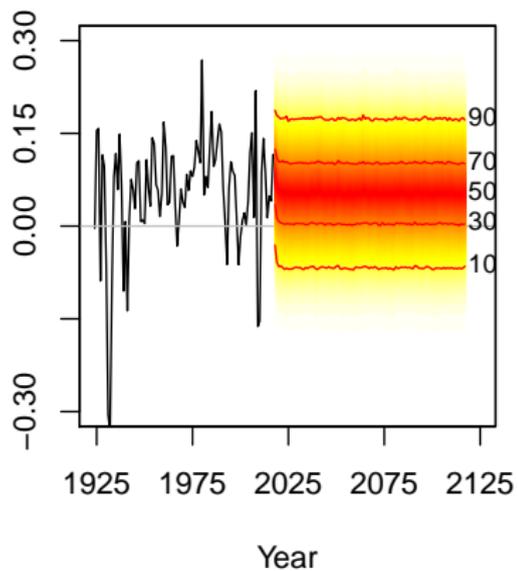
Consols yield
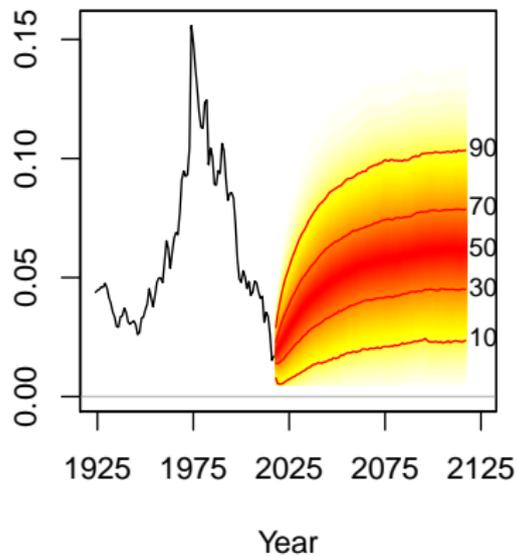
Joint Distribution
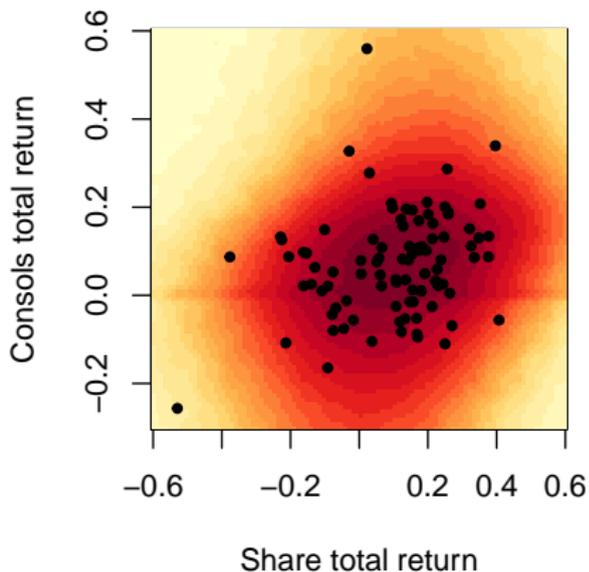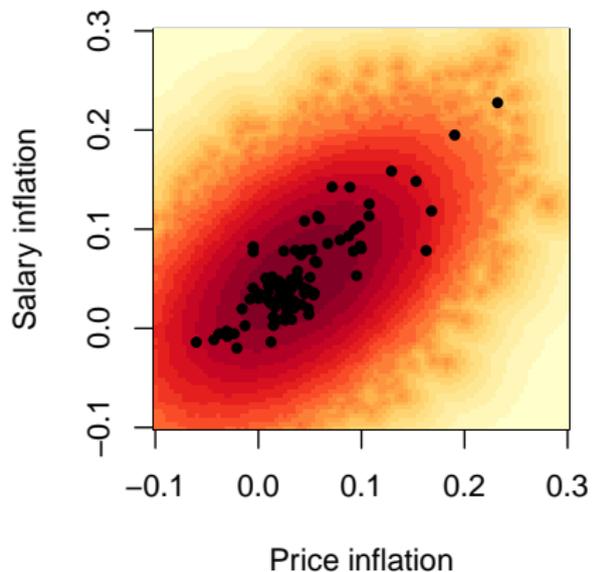
Agenda

Conclusion

Summary

- A simple AR(1) process combined with graphically modelled innovations can generate rich and reasonable distributions.
- Model can be extended to a wider range of economic variables and also for many different countries.

Reference paper

- OBEROI, J., PITTEA, A. & TAPADAR, P. (2018). A graphical model approach to simulating economic variables over long horizons. *Working paper (Submitted)*.

Other references

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- WILKE, A.D., SAHIN, S., CAIRNS, J.G. & KLEINOW, T. (2011). Yet more on a stochastic economic model: Part 1: updating and refitting, 1995 to 2009. *Annals of Actuarial Science*, **5**, 53–99.