The Bank of England’s forecasting platform

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The forecast process: key features

- Each quarter, the Bank publishes an *Inflation Report*, including ‘fan charts’ that depict

  *the MPC’s best collective judgement about the most likely paths for inflation, output and unemployment, and the uncertainties surrounding those central projections.*

- Forecasts are
  - Owned by the MPC
  - Conditional on the paths for the interest rate, the exchange rate, government spending
  - Ultimately determined by judgement, not models

- Forecasting platform
  - Collection of models and tools
  - Supports staff in facilitating MPC discussions
Some comments on design

Central model: COMPASS

Ongoing development

Key elements of forecast platform design

▶ Single model cannot perform well in all roles
  ▶ “Essentially, all models are wrong, but some are useful.” George Box (1987)

▶ Central model to ‘organise’ the forecast
  ▶ Provides baseline framework for consistency of analysis
  ▶ Guiding principles: Theoretical consistency, tractability, flexibility
  ▶ ⇒ COMPASS: Medium-scale new-Keynesian open-economy DSGE model

▶ Use a suite of models
  ▶ Help cope with misspecification of central model
    ▶ Structural and reduced-form models, ranging from single-equation models to alternative versions of COMPASS (e.g. COMPASS with energy)
  ▶ Provide cross checks on analysis from central model
    ▶ Recent effort to revamp suite of state-of-the-art forecasting/nowcasting models
COMPASS flows and sectors schematic

- Households
  - Consumption
  - Business investment
  - Other private investment
  - Government spending
- Government
- Final output
  - Value added
  - Imports
- Exporter
  - Exports
- Importer
  - Imports
- Rest of the world
Key behavioural equations and parameters

- Phillips curves for prices of value-added, consumption, import, exports and labour
  - Price adjustment costs (Calvo in the current version of COMPASS)
  - Indexation parameters and share of firms that follow rule-of-thumb pricing
  - Elasticity of labour supply

- Euler equations for consumption and investment
  - Investment adjustment cost parameter (Tobin’s q)
  - External habits and share of rule-of-thumb consumers

- The world
  - Exogenous to UK economy
  - SVAR of world GDP, world prices and world interest rates

- Export demand
  - Price elasticity of export demand

- Import demand, which arises from the cost minimisation of final goods producers

- UIP condition
Monetary and fiscal policy

- Monetary policy follows a reaction function responding to output gap and CPI inflation, with interest rate smoothing
- Simple articulation of fiscal policy
  - Government spending modelled as stochastic process around trend
  - Lump sum taxes levied on unconstrained households: implies a form of Ricardian equivalence
  - Assume budget balanced each period for simplicity
- Forecasts conditioned on implications of announced fiscal plans and measure of market expectations of Bank Rate
Estimation

- Model is estimated on first differences for all I(1) variables
- Bayesian estimation methods
  - Combine prior information on the parameters with information about the relevant data series
- Data sample 1993Q1–2016Q4 for following variables
  - Real GDP, consumption, (business) investment, government spending, exports & imports
  - CPI, import prices, export prices
  - Nominal exchange rate, “shadow” Bank Rate
  - Total hours worked, wages (AWE)
  - World demand, world export prices
Policy Analysis in COMPASS

Responses to a 50bp increase in the policy rate
Policy Analysis in COMPASS

Annual inflation in deviation from target

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Stochastic Simulations in COMPASS

- COMPASS simulations used to assess if the private sector perceived the ZLB as a binding constraint on policy
Stochastic Simulations in COMPASS

- COMPASS simulations used to assess if the private sector perceived the ZLB as a binding constraint on policy
- Compared deflation probabilities from COMPASS with deflation probability measure from professional forecasters and financial markets
  - Professional forecasters and financial markets identify 2009 and 2015 as periods of heightened deflation risk
  - Model simulations produced with no ZLB also identify 2009 and 2015, while model with an ZLB also picks up 2012-2013
  - While 2009 and 2015 deflation risk is mainly driven by weak inflation outlook, the 2012-2013 is driven by presence of the ZLB
- COMPASS sims suggest the private sector did not perceive the ZLB to pose a significant constraint on policy
- Haberis, Masolo, Reinold (forthcoming IJCB)
Stochastic Simulations in COMPASS

(a) CPI inflation, No ELB
(b) GDP growth, No ELB
(c) Bank Rate, No ELB
(d) Real rate, No ELB
(e) CPI inflation, 0% ELB
(f) GDP growth, 0% ELB
(g) Bank Rate, 0% ELB
(h) Real rate, 0% ELB
Some comments on design
Central model: COMPASS
Ongoing development

COMPASS
Suite of models

Core COMPASS with myopic households

- COMPASS is also a laboratory.
- The assumption of full information rational expectations is often questioned by the Monetary Policy Committee.
  - MPC tend to believe model’s responses are too front-loaded
  - The forward guidance puzzle suggests that indeed the role of expectations in the distant future is too strong
  - In the “natural experiment” of Brexit, consumers responded much less than expected.
- We have experimented with behavioural assumptions:
  - COMPASS with adaptive expectations for all variables but the exchange rate
  - Gabaix (2016)-style behavioral (stripped down version of) COMPASS
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Core COMPASS with myopic households

Annual inflation

Output gap

Bank Rate

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COMPASS: other development in train

- COMPASS with energy
  - Dynamic general equilibrium model that includes a wide range of potential channels through which energy price shocks may affect the economy
  - Households consume ofinal energy goods (petrol and utilities) separately from other goods and services
  - The production of energy and the way that energy enters the production processes of other non-energy goods and services is modelled explicitly.

- Time-varying COMPASS (Kapetanios, Masolo, Petrova, Waldron 2017)
  - Investigate structural change through the lense of COMPASS
  - Bayesian local likelihood methods (Galvao, Giraitis, Kapetanios and Petrova, 2017)
  - Gradual shift to a monetary policy regime characterised by a marked increase in the responsiveness of monetary policy to inflation alongside a decrease in the level of trend inflation down to the 2% target level.
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- COMPASS with financial frictions
Suite of models

- Set of empirical models to cross-check the MPC’s forecast.
  - BVAR, Dynamic factor model, etc

- We are working on a DSGE-VAR for COMPASS (Del Negro and Schorfheide 2004)

- Exploring various models for Brexit
  - class of infinite-horizon nonlinear dynamic economic models in which preferences, technology and laws of motion for exogenous variables can change over time deterministically or stochastically (Maliar et al., 2015)
  - Bilbiie-Ghironi-Melitz (2012) type models to capture the endogenous firm entry/exit dynamics.

- Other modelling approaches
  - Advanced Analytics Division working on agent-based models
Additional slides
Households

- Share $\omega_o$ of households can access the financial markets and are able to save and borrow
  - choose how much to consume/invest/work/hold money to maximise their utility subject to the budget constraint
  - Key frictions they face:
    - external habits
    - wage rigidities à la Calvo
    - investment adjustment costs
- Share of households $1 - \omega_o$ do not access financial markets
  - consume their labour income plus a transfer from the government
  - take wage set by the optimising households as given
  - supply the same amount of labour as optimising households
Firms

- There are 5 types of firms in COMPASS: final output producers, value-added producers, importers, exporters and retailers.
- All monopolistically competitive, bar the retailers.
- In the current version of COMPASS, we model price rigidities according to Calvo (1983).
- In addition to indexation, we also have a (small) share of firms in each sector that do rule-of-thumb pricing (Galì and Gertler, 1999).
- Retailers are perfectly competitive firms with different technologies applying to each separate sector, giving rise to different trend growth rates for consumption, investment, government and trade.
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Trends

- Model includes a permanent labour augmenting productivity shock
  - Expenditure, wages and GDP are all treated as I(1) and cointegrated

- Simple CRS retail sector incorporates determinstic technology trends that can vary by expenditure component
  - Real great ratios and relative prices are trended (trend stationary)

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