To provide a critical review on the current core macroeconomic models employed by central banks to forecast the economic activities and to analyze the monetary policies. We focus on

- US Federal Reserve
  - A large-scale Macroeconometric Model of United States (FRB/US).
  - A New Open-Economy Model of United States (SIGMA).
  - An Estimated, Dynamic, Optimization-Based Model of United States (EDO).
- Bank of England
  - A Medium-Term Macro Model (MTMM).
- Bank of Canada
  - The Bank of Canada’s Quarterly Projection Model (QPM).
  - The Bank of Canada’s New Quarterly Projection Model (ToTEM).
- European Central Bank
  - The New Area Wide Model (NAWM).
  - The Christiano-Motto-Rostagno Model (CMR).

Model Overview

- Large-scale Simultaneous Equation Macroeconometric Models (SEMs)
  - The model is a mixture of structural relations in long run implied by a partial equilibrium treatment of theory (such as the decision rule for aggregate consumption) and some reduced-form short-run relations which employ error-correcting equations.
  - The equations in the model are usually based on four fundamental building blocks:
    - Non-Arbitrage conditions
    - Equilibrium planning (long-run restrictions)
    - Dynamic adjustments
    - Forecasting (expectation formation)
- Structural VAR Models
  - The model aims at providing the VAR framework with structural content through the imposition of restrictions on the covariance structure of various shocks.
  - The model mainly tries to overcome the non-credible identification restrictions.
  - The model is mainly used to evaluate the dynamic response of the economy to monetary policy shocks.
- New Keynesian DSGE Models
  - The model reflects a natural synthesis of the New Keynesian approach and the RBC approach (Neoclassical).
  - Main advantages:
    - Rigorous microfoundation + reasonable fit of the data.
    - Coherent stories + structure forecasts around it.
    - Less risk of over-fitting by helping identify parameters and shocks.
    - Calibration/estimation using off-model information.
    - Impulse-response analysis.
    - Less subject to the Lucas’s critique and more suitable for policy analysis.

### Table: Macroeconometric Models, SVAR, and New Keynesian DSGE Models

<table>
<thead>
<tr>
<th>Macroeconometric</th>
<th>VAR</th>
<th>DSGE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Example</td>
<td>FRB/US</td>
<td>Linear Approx. to DSGE Models</td>
</tr>
<tr>
<td>Dynamic</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Long-run</td>
<td>Based on</td>
<td>Based on</td>
</tr>
<tr>
<td>Relations</td>
<td>Steady State Restrictions in a Coherent Manner</td>
<td>and on Individual Optimization</td>
</tr>
<tr>
<td>Short-run</td>
<td>Based on</td>
<td>Based on</td>
</tr>
<tr>
<td>Dynamics</td>
<td>Ad Hoc</td>
<td>Theory and</td>
</tr>
<tr>
<td>Adjustment Dynamics</td>
<td>Restrictions in a Coherent Manner</td>
<td></td>
</tr>
<tr>
<td>Sims’s Critique</td>
<td>No</td>
<td>Yes (ideally)</td>
</tr>
<tr>
<td>i.e. Impulse</td>
<td>Yes</td>
<td>Yes</td>
</tr>
</tbody>
</table>

### Purpose

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### Common Issues of DSGE Models

- Key components are missing
  - Financial sector is missing
  - Endogenous risk premium is missing (depending on appropriate modeling of financial sector).
    - Equity premium
    - Term premium (e.g. Rudebusch and Swanson, 2012)
    - Currency premium (e.g. Adrian et al., 2008)
    - Credit premium
- Estimation and Solution Methodologies are insufficient
  - First-order approximation (linearization) of the DSGE model
    - It makes reasonable transmission mechanism impossible
    - It makes the estimation severely biased and inconsistent
    - It makes economically important dynamics disappear in the solution
  - How to empirically validate the models
    - Invalid cross-equation restrictions and weak identifications
    - Model fragility and “dark matter” (e.g. Chen, Dou and Kogan, 2013)
    - Filtered or detrended time series
    - Estimating linearized model, which can be alleviated by ABC methods.

### Issues of Ignoring Financial Sector

- Fail to account for important sources of aggregate fluctuations
  - e.g. systemic risk
- Fail to explain regularities of business cycles
- Fail to generate reasonable risk premium dynamics in the economy.
- Fail to analyze crucial policy issues such as financial vulnerabilities, illiquidity or the financial sector’s procyclicality.
- Fail to conduct stress testing in financial stabilities.

### Issues of Ignoring Appropriate Risk Premium Dynamics

- The default premium rather than default probability is informative about macroeconomic conditions (e.g. Gilchrist and Krayardak, 2012).
- Currency premium and sovereign debt premium is important for external borrowing and firm profitability (e.g. Aghion et al., 2001).
- Term premium is crucial to characterize the link between the long-term real interest rates and expected path of the short-term real rates and hence the transmission mechanism of the monetary policy to the demand side.

### A Simple Example

- The aggregate demand relation is built up from the spending decisions of a representative household (C), a representative firm (I) and the government (G) – IS curve
  \[ Y = f(Y, i - \pi - \tau, G) \]
- The aggregate supply relation evolves from the price-setting decisions of individual firms – New Keynesian Phillips Curve
  \[ \pi = f^*(\pi^*, Y, \tau, G) \]
- A simple interest rate feedback rule – Taylor rule
  \[ i = f^*(\pi - \pi^*, Y, \tau, G) \]
  where I is the central bank’s target for the short-term nominal interest rate, \( \pi \) is the inflation, \( \pi^* \) is the expected inflation, \( Y \) is the real output, \( \tau \) is the real tax rate, and \( G \) is the real government spending.

### Issues of Log-linearization

- The likelihood implied by the linearized model diverges from the likelihood implied by the exact model (e.g. Fernández-Villaverde et al., 2006).
- The welfare analysis across policies becomes impossible when the policies do not affect the steady state and risk considerations are relevant.
- The risk premiums will be eliminated by first-order approximation, because, by construction, the risk premium is zero in a first-order approximation, and constant in a second-order approximation.

### Issues of Insufficient Heterogeneity

- The heterogeneity among firms and households, which can cause inefficient resource and liquidity reallocation under frictions and the related externality has crucial equilibrium effect. See, e.g. Aiyagari (1994), Krusell and Smith (1998), Bloom (2009), and Gilchrist et al. (2010).
- It is crucial for policy analysis not only in terms of transmission dynamics but also the welfare considerations.