RBC Estimation Take-Home Project

The purpose of writing any macroeconomic model is to be able to provide credible policy advice. Stakeholders turn to economists when they want to know likely consequences of policy changes. These consequences can take the form of policy hypotheticals, such as the graphs we made using the AS-AD model, or as time series forecasts. The DSGE framework, for all its flaws, remains popular because it can perform these tasks and more. In this take home task, you will see how to transform an abstract mathematical model into these policy outputs. That being said, the purpose of this exercise is **not** to obtain meaningful results, and you likely won't if you choose a country with an economic structure significantly different from that of the USA. The purpose is just to go through the steps, see the types of outputs these models produce, and use your economic intuitions to comment on them.

Basic Information

- Use a DSGE analysis software package to implement the basic RBC model. I will show how to use my own package, gEconpy, for Python[1].
- Submit a 5-8 page paper plus a notebook with your code (see rubric for detailed expectations). **This can be an actual paper, or written in Markdown right inside your Jupyter Notebook.**
- The project will be worth 20 points, and will account for 33% of the final grade (see grading rubric).
- Your project will be due on January 4th .

Tasks

- Select a country. Find at least 2 papers that have fit DSGE models to this country. Find what parameter values they found, and what data sources they used.
- Choose between the closed or open economy RBC model for the model.
    - There will be less guidance for the open economy during TD, but going for the open will lead to bonus points – see notes in the "creative extensions" section below
- Find as much macroeconomic data used in the RBC[2] model as possible, including for: Y_t, C_t, I_t, K_t, N_t, r_t, w_t. Not all of these may be possible to find, but check sources such as the World Bank, OECD, IMF, and country statistical offices. Data should be **quarterly** if possible.
- Preprocess the data as necessary: take logs, remove trends, check for stationarity, train/test split (hold out the last 10% of the data to validate your forecasts). Provide plots and descriptive statistics of the preprocessed data
- Implement and solve the model (steady state and 1st order approximate solution)
- Fit the model to data
- Using fitted values, produce:
    1. Steady state values
    2. Impulse response functions for all shocks
    3. In-sample predictions from the Kalman filter for observed and unobserved variables
    4. Out-of-sample forecasts for variables of interest.

[1] I will not demand you use Python. Other possible options are gEcon in R, or Dynare in Matlab, but I won't provide any instruction for these packages during the TD, so you're on your own if you want to go that route.

[2] For extensions to RBC, such as an open economy RBC, you may need more/different data. For example, you will need trade balance data.

Rubric

- Data (5.5 pts)
  - Data for the correct macroeconomic quantities were gathered (1 pt)
  - Data was correctly preprocessed, including: (1.5 pt)
    - Logs were taken where appropriate
    - Seasonality was removed from the data (if necessary)
    - Annual data were converted to a quarterly frequency (if necessary)
    - Trend component was removed using an appropriate methodology (OLS or HP-filter)
  - Preprocessed data was checked for stationarity using ADF test (0.5 pt)
  - Graphs showing the preprocessed data were presented. Important economic events explaining "spikes" in the data were discussed. (2 pt)
  - Descriptive statistics for the data were presented in a single table, along with a **short** discussion (0.5 pt)
- Calibration (1.5 pt)
  - Write a short literature review summarizing the findings of your two reference papers (1 pt)
  - Present the parameter values you found in the literature. Give economic interpretation to them, and comment on their values relative to the US parameters we saw in class/TD (0.5 pt)
- Model Reproducibility (2 pts)
  - We are able to run your model and reproduce your initial results, including:
    - Model was written into a GCN file that executes without errors (0.5 pts)
    - Model steady state was computed from initial (calibrated) values (0.5 pt)
    - Model perturbation solution was found from initial values (0.5 pt)
    - Model solution satisfied the Blanchard-Khan conditions. Eigenvalue table or plot was shown and discussed (0.5 pt)
- Model Estimation (3 pts)
  - A regression table of estimation results is presented (0.5 pts)
  - Regression results are interpreted, including **sign** and **significance** (0.5 pts)
  - Compare estimated parameters to the initial calibration. Comment. (2 pts)
- Post-Estimation Discussion (5 pts)
  - Model steady-state and perturbation solution was re-computed using fitted values, and the new steady state was presented and briefly discussed (1 pt)
  - Present in-sample predictions for GDP and household consumption. Comment on how well (or poorly) the model fits these two time series (1 pt)
  - Comment **state variables** that drive model dynamics: K_t, A_t. Theorize on what economic events might have caused variations in the latent TFP time series your model generates. (1 pt)
  - Out-of-sample forecasts for GDP are presented. Compare it with data from your test set. How well does this model do at predicting future economic growth? (1 pt).
  - Impulse response functions for each variable/shock pair are presented and discussed. (1 pt)
- Creative Extensions (3 pts)
  This section is a menu of ideas for how you can go beyond the basics we have seen in lecture and TD. Scoring will be based on both ambitiousness and correctness – we want to encourage you to take some risks and try something you find interesting. Here are three ideas, from least ambitious to most ambitious:
  - Try a different utility and/or production function in your model.
  - Code an extension to the RBC model. Examples include capital adjustment or habit formation
  - Add additional shocks to our model, and thus additional time series to the estimation process.
  - Work with the small open economy model rather than the RBC. **NOTE**: If you do this, you will be working with trade balance and international investment position (IIP) data, and you will have to plot and analyze these along side GDP.