Money and Banking - 2025 Homework 1

October 13, 2025

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Question 3 pts (Interbank Market Model Calibration)

- Go over the Afonso-Lagos paper "An Empirical Study of Trade Dynamics in the Fed Funds Market" available in our Courses Readings Folder. Use Figure 1 in their paper to backout the parameters of the OTC model studied in class. For that, you may use the tabulated value for the figure that I provide in the attached CSV file—you can extract better data using an online tool.

  - I used WebPlotDigitizer - https://automeris.io/WebPlotDigitizer/
  - What parameters can be adequately estimated from this data?
  - What are the best fitting parameters that match the evolution of the reserve positions?

- Go to the New York Fed website.

  - Find the corresponding data for the Federal Funds Rate distributions, corresponding to the same year of the plot.
  - Find the data for the volume of the Federal Funds and the Discount Window
  - Find the best parameters to match this data.

- Combining both approaches, calibrate a version of the model to best as possible to jointly match all the data

  - feel free to use an analytic version (e.g., Leontief, Cobb-Douglas, harmonic distribution) or use a numerical approach
  - you can use the code provided in the course's folder.

- What features of the data does the model fail to reproduce for any calibration?

  - Provide a paragraph explaining what would you do to address those issues

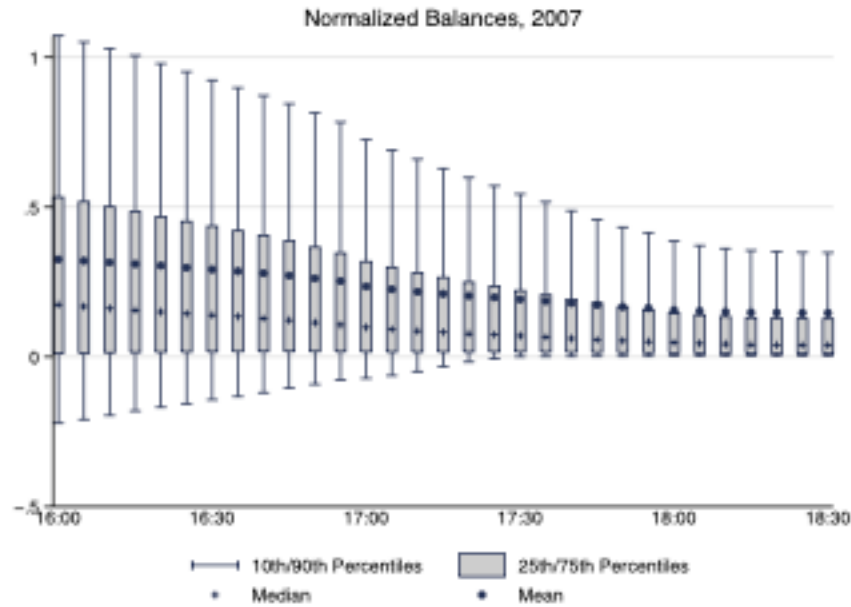Figure 1 in the paper is reproduced here for convenience:

Figure 1: Plot of Interbank Market Positions in Afonso Lagos 2014

Question 4 pts (Interbank Market Model - Networks)

- Go over the Bech-Atalay paper "The Topology of the Federal Funds Market" available in our Courses Readings Folder. The following Figure taken from their paper is an indication that there exists a core periphery structure in the Federal Funds market.

- Write a version of the model where there are two types of banks: core and periphery banks with the following properties

- There are three types of trades (markets if you want)

    - core banks match according to the matching function G^{c2c} corresponding to core-to-core trades
    - core banks with surplus lending to periphery banks with deficit that match according matching functions G^{c2p}
    - core banks with deficit borrowing from periphery banks with surplus that match according matching functions G^{p2c}
    - periphery trades to not exist

- Write the evolution of aggregate positions in discrete time (you should have 4 of them)

- Write an ODE system for market tightness in each of the three markets discribed above

- Write the infinitesimal bargaining problem for all the types of trade

- Write the evolution of $\chi^{\pm}$ for core and non-core banks?

- Describe an algorithm to compute the corresponding objects.

- Write a code that computes the solution to to market tightness forward in time and $\chi^{\pm}$ backward in time

    - plot the average interbank rate among the different types of trade that emerges

- Write a portfolio problem where banks make loans hold reserves and deposits are volatile sources of funding. Explain if periphery banks have an advantage or disadvantage in funding with deposits
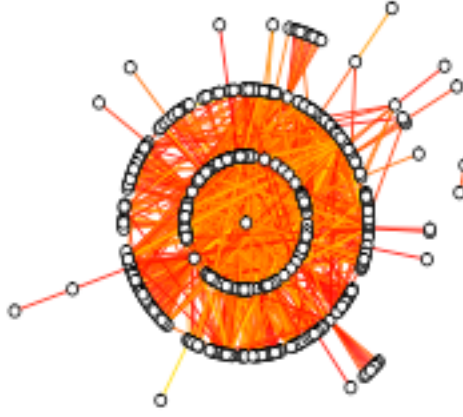
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Figure 4: Federal funds network for September 29, 2006. Largest participant–in terms of value–is in the center. Large value links are in yellow; small value links are in red.

Figure 2: Plot of Interbank Market trades in Bech and Atalay 2008

Question 3 points (Instability) The role of this question is to think of the role of central bank operational targets. Have a look at the paper by Bigio, D'Erasmo, and Yepez (2025). You can observe that from 1990 onward the Federal Reserve's supply of reserves became more and more unstable whereas the interbank ratio became more and more stable.

Consider a risk-neutral bank. It maximizes the following problem:

$$\Pi_t = \max_{\{b,m,d\}} \mathbb{E}\left[R^b b + R^m m - R^d d + \chi(s;\theta)\right]$$

where

$$b + m = d$$

and

$$s = m - \rho d + \omega d.$$

Also, we have that

$$\chi(s;\theta) = \begin{cases} \chi^+(\theta)s & s > 0 \\ \\ \chi^-(\theta)s & s \leq 0. \end{cases}$$

Here, $\{\chi^+(\theta), \chi^-(\theta)\}$ follow from the OTC model derived in class. You don't have to derive the formula. For the entire question, use $\{\chi^+(\theta), \chi^-(\theta)\}$ implicitly—use these symbols, you DO NOT need to apply the formulas in terms of the primitives $\{\lambda, \eta\}$.

- Let the random realization of outflows, $\omega \in \{-\delta_t, \delta_t\}$—note that in expectation, some banks suffer an outflow of deposits whereas others an inflow. Both events happen with equal probability.

  - note that δ_t is a random variable
  - assume that it follows an AR(1)

- Also, for simplicity assume the demand for deposits confronted by the bank, d, is perfectly inelastic

 - by contrast assume an iso-elastic demand for loans by banks, b, e.g.:

$$b = \Theta\left(R^b\right)^{-\zeta}.$$

- a) Please derive the *liquidity premium and a deposit premium, as well as the intebank-market spread.* That is, derive:

$$R^b - R^m, \quad R^b - R^d, \quad R^f - R^m$$

Feel free to assume: $m - \rho d - \delta d < 0$ and $m - \rho d + \delta d > 0$ for all t. Also, remember θ is given, from the individual bank's perspective of this bank.

Figure 5: Historical Spreads Ratio and Liquidity Ratio
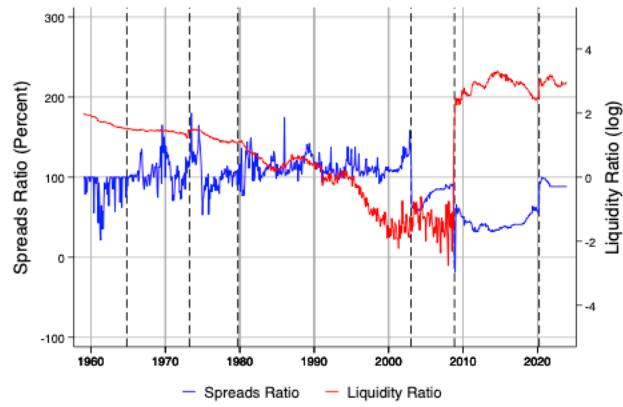
Note: The panel displays the spreads ratio (blue line, left axis) and the liquidity ratio (red line, right axis).
The spreads ratio is defined as $(DFF - IORB)/(DWR - IORB) \times 100$. The liquidity ratio is the natural log
of the ratio of reserves to commercial bank deposits expressed in percentages $(log(reserves/deposits \times 100))$.
Series are plotted as weekly observations (Wednesday values). Vertical dashed lines mark the following
policy-regime dates: November 1964, April 1973, October 1979, January 2003, November 2008 and March
2020. Source: Federal Reserve Bank of St. Louis FRED.

Figure 3: Plot of Liquidity Ratio and Interbank Rates in Bigio, D'Erasmo and Yepez

- b) Assume that the central bank has a policy to fix m at some preditermined value

    - report the volatility of the corresponding spreads

- c) Suppose now that the central bank has a different target, that of targeting R^f, the interbank market rate

    - assume that the central bank observes δ_t contemporaneously
    - assume that the central bank observes δ_t with one lag

    Report the volatility of all three spreads in each case. If the answers become complicated, use a computer to simulate.

- Using Chat GPT or any other LLM of your choice, research the debates regarding the move away from aggregate monetary targets to interest targets. Do you find anything in these policy debates regarding